THE TELEGRAPHIC JOURNAL AND

Electrical Review.

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THE THEATRICAL MOLOCH.

THE gas-demon has again scored a deplorable triumph. The Grand Theatre, Islington, has shared the fate of that at Exeter, of the Opéra Comique and of the Ring Theatre, and is now a mere blackened shell enclosing scorched rubbish. True there has been this time no sacrifice of human life. Yet this exception is evidently due not to human skill or foresight but simply to what we are in the habit of calling accident. Had the conflagration broken out a little sooner, the civilised world might now have been shuddering at the news of hundreds of men, women and children roasted alive, suffocated or trodden to death in attempting to flee from the approaching fire! The combined skill of architect and builder is powerless to construct a theatre which is "fireproof." The "Grand" was probably as near an approach to this desirable state as such places of amusement ever will be, yet it consumed away as quickly and as completely as if it had been a most inflammable fabric. We agree with the *Referee* that managers must not shield themselves any longer behind the cry of so-called fireproof construction, and the question is now how many more lessons of this kind, or of a worse, will be needed before we can make up our minds to accept the means of safety? Shall we still hesitate and palter and propose compromises until a Prince of the Blood or a Premier has been sacrificed? Or shall we, as a nation, demand that the gas-demon be exorcised — completely and finally banished from all theatres, music-halls, and other places where crowds of people are in the habit of congregating by artificial light? Surely to this there can be but one answer. If we have any remnant of common sense, nay, it might be said, any of that instinct of self-preservation in which even the lowest animals are not lacking, our course is clear. The electric light, and that only, must in future be used in theatres. The recent catastrophe shows most distinctly the insufficiency or the folly of half measures. The "Grand" was lighted partly with gas and partly with electricity. And how was the task shared between these rival illuminating agents? In a manner which, were the subject less serious, might pass for a joke. The auditorium, where the risk of fire is comparatively trifling, was lighted electrically, whilst gas was allowed to flare in its customary manner behind the scenes, in the flies, and, in short, wherever it had the greatest chance of working mischief! Who must be considered the responsible party for this most unhappy arrangement it is no business of ours to inquire. But evidently upon the mind of such person or persons all the writing and discussion on the perils of gas burning in close proximity to highly inflammable matter had produced no impression. Even the stern logic of facts had been disregarded.

We must never forget that the scenery and all other stage fittings of a theatre lighted with gas present elements of danger equalled nowhere save in a powder magazine or an oil or spirit store. There are textile materials, and thin wooden articles not merely dry, drier than we ever find them elsewhere, but from being constantly immersed in hot air they are rendered almost spontaneously inflammable. The slightest spark, or the most momentary superficial contact of flame, is all that is required to convert the potential danger into an actual catastrophe.

We may here see how, with such super-combustible materials to deal with, the ordinary precautions vaunted by the proprietors of theatres proved idle. There was a fireman appointed to keep his eye on any appearance of danger, and it does *not* seem that he was inattentive to his duties. There were hose for pouring down a deluge of water upon the fire at the very outset, but as is too often the case—

> Man may not fetter, nor waters tame,
> The might and wrath of the rushing flame.

Instead of seeking to extinguish we must prevent, and to prevent, we must cut off the only source of the mischief. In other words, there must be no open flame, nothing which can heat the woodwork and the painted canvass, or set light to the properties. That is, gas must not be introduced at all, and we are glad to observe that this will be the case in the reconstruction of the Grand. Any light which may be required by the actors and others engaged about a theatre, either before or after the actual performance, can readily be supplied by primary battery lamps, such as those of Schanschieff, who has devised a special form for this very purpose.

Fortunately no Act of Parliament is necessary to banish gas from our theatres. Let the authorities make its absence a prime condition on which a licence can be granted.

Electrical Plant says: "In every properly equipped installation there is now as much reliability as in any arrangement comprising a high class steam engine, and when it is remembered that nearly the entire manufacturing world depends upon the regular driving of the steam engine, the public will be quite content to have the electric light upon the same condition." With all due respect to the opinion of our contemporary, we think it has misjudged both the public and the matter of artificial illuminants. What would be thought of a gas company which employed machinery only sufficient to produce at the time when wanted the maximum amount of gas? No; electrical energy must, like gas, be stored, before the public, as a body, will be content with electric lighting. Any accident to the generating plant—and some hitch or other must necessarily occur in due course—must be compensated for by a sufficient storage to bridge over the time required for repairs. In this way only can electric lighting be made as reliable as gas, and anything less trustworthy will not be tolerated for any lengthy period.

IN advocating the adoption of the electric light in all public places of amusement, we are not unmindful of the fact that even electricity can be made the means of causing a conflagration, but not if all the conditions of the installation are properly carried out. For this reason, therefore, it is essential that no part of the work should be scamped and that the services of a competent man should be secured to insist that all necessary care shall be scrupulously observed. The circuits should be so arranged that a failure in one need not cause the extinction of all the lamps, and above all it is incumbent upon those concerned that secondary batteries should form part of the plant. Engines, whether employed for electric lighting or any other purpose, are not infallible; but the addition of accumulators to the installation eliminates the effect of a breakdown in either engine or dynamo, and this fact cannot be too forcibly impressed upon theatrical lessees and managers.

WE were under the impression that theatres were compelled to adopt two methods of illumination, one to be kept in reserve, *i.e.*, electricity and gas, or gas and oil, &c., &c. Mr. Rashleigh Phipps, however, who is an authority on anything appertaining to public places of amusement, informs us that there is no compulsion in the matter, neither is there any mention of it in the Board of Works' or the Lord Chamberlain's rules and regulations, but that by the *request* of the Lord Chamberlain, two modes of lighting are in general use in all the London theatres.

A CONTEMPORARY, in a retrospect of 1887, gives vent to the following remarkable fact:—"For isolated buildings of large dimensions, factories, mansions, &c., where gas is either *dear* or *unattainable*, it has been proved, over and over again, that the electric light is the cheapest." This is a truism which must be apparent even to the average understanding, but further on we are met with the grave statement that where gas is *very cheap* it is doubtful whether the electric light can be supplied at a profit. The author of these sage reflections must surely have at some remote period belonged to the staff of "Old Moore's Almanack."

Apropos of the subject of curative electricity, and the attention it has received in these columns, we understand that an "Institute of Medical Electricity" is about to be established, under excellent auspices, having the following objects: 1. To provide an institute where, or in connection with which, people of small and limited means may obtain electrical treatment under the direction of qualified medical men, for the cure and relief of diseases, at moderate fees. 2. To encourage by scientific investigation and other approved means, the development of the science of medical electricity. 3. To provide a means by which medical men can obtain the use of reliable electrical apparatus and instruments for the treatment of their patients either at the institute or elsewhere. Several eminent medical, electrical and scientific men are among its supporters, and it may, therefore, be confidently expected to prove a very useful institution; and as the public will thus be provided with an opportunity of obtaining electrical treatment under direct medical supervision, instead of running blindly into the hands of the more than questionable fraternity we warned our readers against last week, there can be little doubt that the institute will prove a great success. We will gladly welcome the Institute of Medical Electricity, for some such place where medical and electrical scientists can join hands and apply legitimate and sensible electrical treatment to suffering humanity is much needed. Further information may be obtained from Mr. H. Newman Lawrence, A.S.T.E., at the temporary office of the institute, 16, Clifford's Inn, Chancery Lane, E.C.

IT was rumoured last week that the electric lighting of Winchester House had been abandoned, and gas substituted in its stead. This turns out to be incorrect, as the real truth of the matter is that the installation has just been doubled. During the alterations to two out of three boilers it became necessary to supply the lighting of the main building for a few days by means of oil lamps. So far as the secondary battery part of the plant is concerned, it has been put aside, as there appeared to be no alternative between this course and that of largely increasing the number of cells. We are glad to be able to give official denial to the reports which reached us through apparently reliable sources.

GAS engine improvement is a subject which cannot fail to arouse the strong interest of the electrical engineer, for every addition to the percentage of efficiency in gas engines means a reduction in the cost of producing the electric light. The past history of the gas engine is encouraging, and points to the possibility of further advances. In 1860 its efficiency was 4 per cent. at which figure, or thereabouts, small steam engines have remained stationary to the present day; but in 1886 it had been so far improved that 18 per cent. of all the heat supplied to it was utilised as work. Even the largest and best steam engines can scarcely go beyond an efficiency of 12 per cent., so that it may be seen that the gas engine promises far more, for small power purposes, than the steam engine. In his new book on "The Gas Engine in its Historical Development: its Theory and Practice," Dr. Schwartze has ably discussed the interesting question of the possibility of effecting a still further economy. The improvements since 1860, he says, have been due not only to alterations in structural details, but to the adoption of compression; and he asks, Could this be carried further? He thinks not, agreeing with Dugald Clerk. The weak point of the present engine is the insufficient expansion. If it were possible to expand so as to bring the pressure down to the atmospheric, the efficiency in Otto's motor ought, theoretically, to be 50 per cent. The writer seems to regard it as a matter quite within the range of possibility to apply this principle and attain an efficiency of at least 25 per cent. Further reduction of the loss of power, he then argues, might be effected by lessening the the cooling surface to which the volume of hot gases is exposed, and by that means reducing the loss of heat through the cylinder walls; and he points to a wider cylinder as the best method of attaining this end. Increased piston speed in the larger engines and the heating of the cylinder walls would also tend to check this, the greatest source of loss of power. Dr. Schwartze sees no insuperable difficulty in arranging, even with machines built upon existing lines, for greater expansion, greater piston speed, and hot-jacketing the cylinder, so as to attain an efficiency of about 40 per cent. May the good day come soon when this anticipation will be realised!

THE series of articles written by Mons. E. Wimschendorff, and which have appeared weekly in *La Lumière Electrique* since July 2nd of last year, have apparently reached their final stage. The articles are divided into five sections: the first deals with the general history of submarine telegraphy; the second describes the composition and manufacture of cables; the third treats of the machinery employed in laying and repairing work; the fourth (just concluded) explains the apparatus, methods, and formulæ for testing, and for localising faults; the fifth section will contain an account of the instruments and systems adopted for working submarine cables. Fairly interesting as a whole, we cannot discover anything new in the articles referred to, they being composed, for the greater part, merely of translations from our standard works. To many French telegraph engineers they will, however, have a greater value, as but few of them have any experience in submarine telegraphy.

A VERY pretty little case for the lawyers is now before the Brussels courts. A firm of engineers—Girard and Company—sue the proprietor of the Grand Hotel for the recovery of the value of an electric light installation. The hotel proprietor, on the other hand, demands that the firm of engineers shall take down the installation, which he declares to be defective, and claims as damages the sum of £1,000 for injury to property and detriment to business. The case has already come before the tribunals ten times and is only in its infancy, so there will probably be some nice pickings for the legal fraternity.

AN ingenious form of regulating arc lamp has been designed by M. A. Ulke, and is described in *Elektrotechnischer Anzeiger*. The carbon electrodes are inserted in two metal tubes, being fitted in the latter as pistons; the other ends of the tubes are of glass and pass to the bottom of an air-tight vessel filled with acidulated water. Platinum electrodes are placed in the tubes voltameter fashion, these electrodes being connected one to each carbon electrode, and also to the source of power. The carbon electrodes being separated, the current passes by the metal electrodes and decomposes the acidulated water, the gas so generated presses against the carbon electrodes and forces them together, causing the arc to start through the medium of a small fragment of carbon which is in the first instance placed between the points. The resistance by the carbons now being less than that through the platinum electrodes and the acidulated water, the current through the latter becomes weak, and the decomposition becomes slow; as soon, however, as the arc becomes lengthened more current passes through the water, the gas becomes energetically given off and pressure is exerted on the carbons and brings them closer together again. The working of the lamp is said by the inventor to be very satisfactory.

IF Mr. Reckenzaun's conclusions are correct (and we can hardly doubt the reasoning of one so invariably careful in his statements) respecting the effect of the density of the electrolyte in secondary battery determinations, it is evident that the tests of the Julien accumulator, which we publish this week, will be viewed with a certain degree of distrust. Sir David Salomons should be able to give us absolutely reliable information, deduced from practice, upon this point.

THE lecture which Prof. Silvanus Thompson recently delivered upon the mercurial air pump before the Society of Arts is doubtless the most exhaustive of its kind, and the information there given will assuredly be of great value to the manufacturers of incandescent lamps. We have to acknowledge the kindness of Prof. Thompson in correcting proofs during the publication of the paper, which ended with our last week's issue.

MR. THOMAS D. LOCKWOOD has the enviable power of making every subject he touches interesting. An instance may be found in the pages of the *Electrician and Electrical Engineer*, of New York, for December, where Mr. Lockwood has an article on "Cheapness and Economy;" in mirthful but trenchant language he wages war against the "Cheap John" in applied electricity, whose moving principle, whatever his motto, is "Millions for repairs but only a cent for construction." It took the successive attacks of Varley, Pope, Brooks, and many others, he says, plus an immense amount of costly experience, before the cheap idea was dislodged from the telegraphic systems of the country (America, this, of course). Even then it was and is difficult to keep it permanently out of the field. In many cases the people who guide or control the purse strings of even great telegraph corporations are still unable to look at many items from any other point of view than that of first cost; hence the evil Mr. Lockwood decries is only scotched, by no means killed. The writer traces that interesting gentleman, "Cheap John," throughout electrical industries, and concludes with these pithy sentences:—"All electricians who believe in the future of electricity ought to unite in a war of extermination against cheapness in applied electricity, wherever they see that it involves inefficiency and danger. The Cheap John must reform or go. The Cheap John cannot reform, therefore—the Cheap John must go."

YET another theatre, this time at Bolton, has been destroyed by fire. The occurrence took place early on Wednesday morning. After the performance of the pantomime on the previous night the building was safely closed; but a few hours later flames were seen coming through the roof over the stage, and the building was soon gutted. The theatre was fitted with automatic sprinklers, and the proprietor was so confident of their efficiency that he had offered as a test to set fire to the stage if anyone would pay the damage done by water if the fire was extinguished by the sprinklers, he to bear the loss if it was not. On Wednesday morning, however, it was found that the water had by some means been turned off, so that the sprinklers could not act. This, it is assumed, was wilfully done, and the proprietor alleges that he has proof that the fire was the work of incendiaries. The pay-box bears traces of having been forced, whilst the strap connecting the valve to the sprinklers was found cut, evidently with a sharp knife. It is a curious but unhappy fact in connection with this catastrophe that Mr. Elliston, the proprietor, had just engaged several *artistes* who were thrown out of their employment by the burning of the Grand at Islington. On the previous evening a fire broke out in the Belfast Theatre Royal, but this was extinguished in about 20 minutes by the combined efforts of the fire brigade and persons in the building, the damage being but trifling, and almost wholly confined to the scenery.

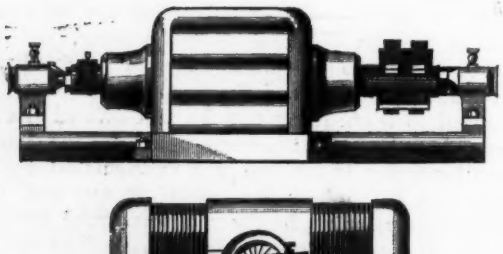
CONTINUOUS CURRENT TRANSFORMERS.

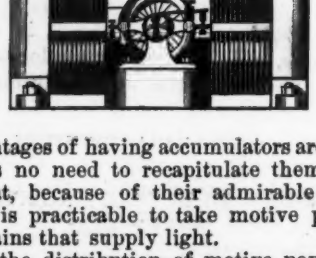
THE action of Messrs. Paris and Scott's continuous current transformers, which are here illustrated, is very simple and easy to be understood by anyone acquainted with dynamo-electric machinery. There is an armature with two sets of conductors and two commutators revolving in a constant field, the magnets being excited by a shunt in the low tension circuit. The ratio of the number of turns in the one conductor on the armature to that in the other is the ratio between the E.M.F. of the primary and secondary circuits.

In working, the primary is the motor circuit and the secondary the generator circuit, and as the current in the one is in the opposite direction to that in the other, the effects of self-induction and Foucault currents due to currents in the armature and lead, are said to be neutralised the one by the other.

The transformer at Newcastle was a small one, being tested with an output of only 4 units, when only 3 per cent. was found to be required for driving, showing a conversion efficiency of 97 per cent. The speed was 1,200. Since that apparatus was designed great improvements have been made, so that now, by running at a slightly higher speed, the electrical loss in large transformers such as would be used in practice is under 4 per cent., and as the power absorbed in driving a large transformer would naturally form a smaller percentage than in a smaller one, a commercial efficiency of some 94 per cent. can be counted upon.

As there is some misconception as to what is the natural domain of the continuous current transformer, one of our contemporaries having just published a comparison between the cost of distribution, first by accumulators; secondly, by continuous current transformers; and thirdly, by alternate current transformers; it may here be asserted that one of the most important advantages of continuous current over alternate current transformers is that they can be used in connection with accumulators. Another great advantage is that motive power can be distributed from the same central station. With this end in view it will be advisable to employ only a moderate E.M.F. for the high tension circuit, say 600 volts on the three-wire system, and for lighting and very small power transform this into 100 volts, having accumulators in parallel with the lamps. These would discharge when the demand was at its maximum, and be charged when it was least, thus reducing the capital required for engines, dynamos, &c., at central stations.





The advantages of having accumulators are so obvious that there is no need to recapitulate them. Not the least is that, because of their admirable regulating qualities, it is practicable to take motive power from the same mains that supply light.

Although the distribution of motive power by electricity has so far made little headway in England, yet it is very probable that in certain districts it will become before long more important and profitable than the lighting.

It is quite impracticable to distribute power up to 20 or 30 H.P. with an E.M.F. of 100 or 200 volts, but with 600 volts on the three-wire system it is quite practicable. Large motors might be connected up between the two outer wires, when 35 H.P. would only require a No. 8 wire. Where possible, the field magnets of the motor would be connected up to the low tension circuit; where this could not be done the motor armature would have a small secondary circuit and commutator for exciting the field magnets. The motor would then run at a practically constant speed without any regulating appliances. They would require very little room and attention, and for this reason, even if the cost of electrical power came to the same as power from a gas or a steam engine, there would be but few who would hesitate between them. The question is, can power be supplied as cheaply by electricity as it is obtained at present? Without going into exact calculations, the following figures will enable our readers to form an opinion for themselves. It is acknowledged that for continuous work, except for small powers, a steam engine is cheaper and more satisfactory than a gas engine. Now, steam engines up to 20 or 30 H.P., as they are usually worked, take from three to four times as much coal per H.P. as the large and well-managed engines in a central station would require, besides which they each require a man to look after them, and a considerable quantity of oil waste is involved; these items would in a central station be immensely reduced, so it is plain that even with a loss of 30 per cent. between the engine at the central station and the work to be done, power could be supplied at the same price as or for less than it costs at present, leaving a large margin for interest, profit, &c.

By thus combining the distribution of motive power with lighting from one central station, the financial aspect of the whole affair is greatly altered for the better, for instead of the expensive machinery being only employed at its maximum for a few hours in the day, and for many hours doing little or nothing, it is kept employed near its maximum for many hours, and by using accumulators almost continuously.

ELECTRIC WELDING.

THE art of welding iron and steel by means of the heat of an ordinary fire is many centuries old, and it is perhaps one of those simple operations which would hardly be considered a subject for improvement; but the invention of Prof. Thomson,* says the *Scientific American*, not only facilitates the welding of iron, steel, and such metals as have heretofore been welded by the old time methods, but permits of the welding of cast iron, copper, brass, German silver, zinc, aluminium, and other metals which have generally been considered poor subjects for the welding process. Besides these, this new process has been successfully applied to the welding of unlike metals; iron and German silver, iron and brass, being examples.

The electrical welding process is not particularly adapted to job work, but in the regular manufactures, such as the making of chains, wood and iron working tools, the welding of carriage axles, the joining and repairing of shafting, the joining of wires in electric factories, the union of long pipes for coils for special purposes, the making or repairing of endless bands, such as band saws, wheel tires, barrel and tank hoops, it finds its legitimate application. It also finds an extensive application in shops, for lengthening screw taps, drills, reamers, augers, in mending chisels and punches, lengthening screws, bolts, bars, or shortening them by cutting out sections, and for renewing the cutting edges of lathe tools. The number of applications of electric welding to work of this kind seems to be almost endless. Electric welding is adapted to much of the work of the jeweller. A large proportion of the gold work now soldered may be welded. In the manufacture of gold rings it will be particularly advantageous, as it renders the ring of uniform fineness throughout.

* See ELECTRICAL REVIEW for last year.

For welding electrically, a current of great volume or quantity and very low electromotive force is required. It may be furnished directly by a dynamo of peculiar construction, or the current from an alternating machine of high electromotive force may be used by employing a transformer capable of delivering a current of low electromotive force and great volume. Practically, the current used in welding has an electromotive force of from 1 to 2 volts, while its volume may range from 1,000 to many thousand ampères, depending on the nature and size of the bodies to be welded.

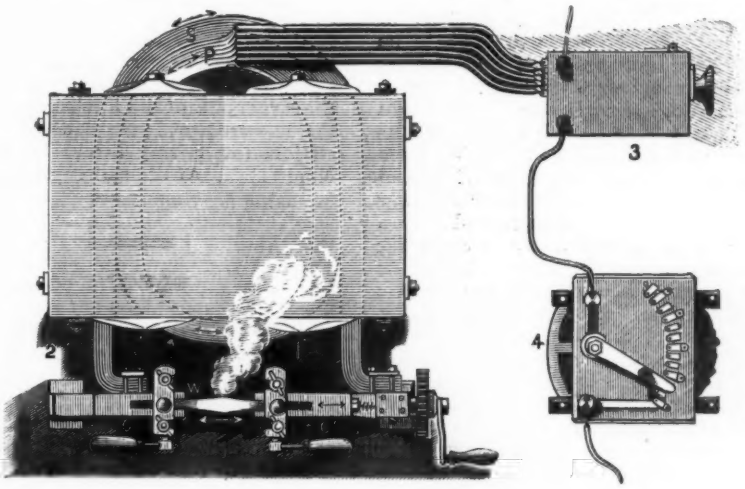
In the exhibit at the American Institute Fair, New York, the primary current was furnished by a Thomson-Houston self-exciting alternating current dynamo. This current, circulating in the primary wire of an induction coil of peculiar construction, generated in the secondary conductor of the coil a current suitable for welding purposes. The dynamo used in the present instance consisted of series of field-magnets arranged in a circle and connected so as to present opposite poles in alternation. The armature was made of a series of thin iron discs fastened together to form a cylindrical core, and a number of flat spirals one wire in depth, mounted on the periphery of the core and connected with two terminals leading to two collector cylinders on the armature shaft. Under the flat spirals, or "pancake coils" as they are called, were placed a few coils arranged according to the Siemens system, and connected with a commutator upon the end of the hollow shaft. The current taken from this commutator was employed solely for exciting the field-magnet, while the alternating current from the collectors was used in the welding apparatus.

Referring to the fig., the current from the dynamo is conducted to one binding post of the commutator, 3, which is arranged to send the current through one-sixth, one-third, or one-half of the primary wire, P, of a transformer or induction coil. The primary wire of the transformer is small and long. The secondary conductor, S, is very large and short, and the body of iron forming the magnetic field is placed in proximity to the primary and secondary conductors. The remaining binding post of the commutator, 3, extends to one terminal of an isolated primary coil, 4, the remaining terminal being connected with the dynamo. The coil, 4, is provided with a switch by which any number or all of its convolutions may be cut out or placed in circuit at pleasure.

The rods to be welded are placed in the clamps, C, C′, the fixed clamp, C, being connected with one terminal of the secondary conductor, S, the movable clamp, C′, being connected electrically with the remaining terminal of the secondary conductor. The movable clamp, C′, is arranged to be moved forward toward the fixed clamp, C, by means of a screw. The rods are filed and rendered slightly convex at the abutting ends, and the rod carried by the movable clamp is brought into forcible contact with the rod supported by the fixed clamp, when an appropriate flux is applied. The current is then switched on to the primary in such a manner as to cause it to traverse one-sixth, one-third, one-half, or the whole of the wire, according to the requirements of the work in hand; or the two halves of the primary may be arranged in parallel circuit. The contact surfaces of the rods to be welded at once begin to heat, and the movable clamp, C′, may be advanced as fast as the softening of the abutting ends of the metal will permit.

For the nicer adjustment of the current, more or less of the coil, 4, is introduced into the circuit by means of the switch, and the inverse electromotive force generated in this coil serves to oppose the action of the current in the primary coil, P, more or less.

When the weld, W, is complete, the primary circuit is interrupted and the work is removed from the clamps. The time required for producing a perfect weld is but a few seconds on ordinary work. The work may be hammered while the welding progresses, and it may be even removed from the clamps and hammered, replaced, and reheated, if necessary, the heated portion of the metal increasing the electrical resistance so as to confine the further heating to the same part of the metal.



One of the important features of this invention is that the metals are heated uniformly during electric welding. This results from the fact that cold metal is a better conductor than hot metal, and that, therefore, any cooler line of particles in the sections at once becomes a path for increased current and is brought up in temperature to equality with the other portions.

The absence of the dirt of the forge and cinder, common to the old method, is a decided advantage. The process is perfectly safe, and is so simple that it may be easily conducted by unskilled labour. The economy of electric welding is very great, and the range of work to which it is applicable is almost unlimited.

A YEAR'S ELECTRIC LIGHTING IN SHEFFIELD.

SHEFFIELD, like the poet Goethe, may without greediness long for more light. It is an extraordinary town. One writer has spoken of it as: "This infernal city, whose water is blacking, and whose air is coal;" and it certainly looks black and repellent enough on a wet or foggy day, when the smoke from its furnaces and big works hangs sulkily overhead, or falls in sooty flakes on

the heads and faces of the philosophical inhabitants. At night the town (if you are only on the fringe of it) looks very pretty, with its glare of furnaces and lines of lights running up and down its hilly streets; but if you traverse the streets they are the reverse of cheerful; muddy, gloomy, badly lighted. Gas is cheap in Sheffield (though neither so cheap nor so nasty as in Leeds); but there is a dearth of lamps in many of the thoroughfares, even in the most important business ways, and it must be said, notwithstanding the town's manufacturing and commercial progress, that it is still very much in the dark. But as the darkest hour always heralds the dawn, there is every probability that in the next decade Sheffield will get a great deal more light. It is just a decade since the people of the town became familiarised with the electric light—one memorable night in 1878, when a football match was played in the brilliant and yet soft light from the four arc lamps hoisted in the Bramwell Lane Cricket Ground. Thousands of persons watched the game played under such a novel condition, or, rather, such a novel illumination of the ground at night; and there were many prophecies that gas was doomed—that in a twinkling, as it were, Sheffield would adopt the electric light. There is no doubt whatever that the new mode of lighting, introduced to the town by Messrs. John Tasker and Sons, of Angel Street, did cause a flutter among the holders of gas share scrip. But it was only a temporary flutter. The shareholders of the local gas company soon regained confidence in the stability of their undertaking; and they did much to increase its security, by not only improving the quality of the gas supplied to consumers, but by supplying it at a cheaper rate than heretofore. So, after all, the electric light was only like a will-o'-the-wisp in the night. It was followed, gazed upon with surprise and wonder for a little while, and then it disappeared from view, and was well-nigh forgotten. But it was neither lost nor extinguished. "It's all right for t' stage and fairies, but it'll not do for ar shop," said a big steel melter down at Brightside, who is prejudiced against what he calls new-fangled notions, and thinks that the electric light is "too beautiful to last." Business men shied at it, fearful of expense. Yet the light kept appearing furtively about the town; shining in altogether unexpected places. "Why, Bill, has thah heeard as Rodgers' as get t' electric light?" asks a filemaker of his mate. "Ah, lad; and they've get it at Spear and Jackson's ano." These are truths. At the Etna Works of Messrs. Spear and Jackson, edge tool manufacturers, there is now a dynamo driving six arc lights; at Messrs. Joseph Rodgers and Sons, Limited, the noted cutlery works, there are 40 incandescent lights driven by a Siemens's shunt-wound dynamo; and at the present moment Messrs. Tasker and Sons have in hand a contract for electric lighting the extensive offices of Messrs. Charles Cammell & Co., Limited, armour plate manufacturers, of the Cyclops Works. A few years ago it would have been considered altogether Utopian to hint that the time would come when a great Sheffield concern would carry on its industrial operations by the help of the electric light; but so rapidly do invention and business enterprise march onward now-a-days, that it is not at all Baron Munchausen-like to prophecy that within the next few years many of the big mills, the armour plate mills, the rolling mills, the gun shops, the cutlery manufactories, even the dark places in which the pearl-shell cutters work will be bright with electric light. Nor does it smack of romancing to say that in the next decade there will be quite a revolution in the lighting of Sheffield places of business, the great shops in the chief streets—nay, the revolution has already started. No town in England (bearing in mind its deep-rooted prejudice in favour of gas) has made more satisfactory progress during the past year in electric lighting than Sheffield. The small installations of a year or two back let some light into prejudice; and the establishment that Messrs. Tasker & Sons have erected at the bottom of Commercial Street, near the Midland Station, at Sheffield, is doing a great deal to drive that prejudice away. It is incredible, indeed, that this firm have done so much, have triumphed over so many difficulties, as local champions of electric lighting. It was only on December 17th, 1886 (little more than a year ago), that they opened this depôt, or central station as they style it, with the Thomson-Houston system of arc lighting. A 45-arc light machine was placed in a substantial dynamo-room, and got to work without delay. In a few months the whole of these 45 lights were taken up; and in the autumn of 1887 an entire rearrangement of plant was necessary, owing to the increasing demand for the arc light in the town. Three 50-arc light machines, each of 2,000 candle-power, have been added to the plant; and of these lights between 70 and 80 are already in use in Sheffield business places, some of them a mile away from the central station. This new method of lighting premises is, in fact, becoming very popular in the town—people are beginning to have faith in it—they find it is a light to be relied upon, that it has gained a character for steadiness. As an instance of the growing favour of the arc light it may be mentioned that the following business premises and resorts have adopted it practically within the past year:—The Central Cafe, High Street, where the lights are used for the billiard tables, as well as for the refreshment part of the premises; the Northern Stores, more familiarly known as Tuckwood's, in Fargate, a fine business place, with 12 arc lights; the Clothing Hall, in High Street; Messrs. Atkinson Brothers, on Sheffield Moor; Hill's Government Stores; Bramhall's, the poulterers; Harrison's, the hosiers; the Alexandra Opera House, for a street light; the Maunche Hotel, at the corner of the Corn Exchange; the Garrick Hotel, near the Theatre Royal; the Midland Hotel, near the railway station, the Surrey Street Music Hall, and the Star Music Hall. At their own premises, too, Messrs. Tasker and Sons have many arc lights in use, and the effect is very brilliant. The whole of the arc lights used at these various business and other places are driven by a pair of compound condensing engines of 200 (indicated) horse-power, so that there is a margin of power for further development. A Phœnix dynamo is also used for charging storage batteries utilised in lighting the offices of the firm, and for the wants of customers in the locality.

Perhaps the most novel feature of the development of electric lighting in Sheffield is in relation to the small-pox epidemic. The disease, as is well known, has ravaged the town, causing something like a panic and many deaths. The Fever Hospital is crammed with patients. The epidemic is rather increasing than decreasing. Isolation is the cry; and day and night the builders are working on a hospital right away out of the town, in the midst of the moors, at a bleak place known as Redmires. It is absolutely necessary for the health of the town, for the safety of its people, that this new hospital should be finished in thirty days. The weather up there on the moors, bordering the wildest part of the Peak of Derbyshire, has been terrible; snow, ice, wintry wind—but by the aid of the electric light, driven by a 40-light Thomson-Houston dynamo, the men have been able to keep at their work night after night, and the contractors report that the hospital is well in hand. There is a touch of sentiment about this novel application of the electric light; it is the first time, so far as Sheffield is concerned, that it has been called in to aid physician and sanitary science in checking a grievous epidemic.

Possibly there may be many further developments of electric lighting in Sheffield during the new year; but it is not very probable (bearing in mind the interest some of Sheffield's public men have in the local gas company) that the electric light will supersede gas in the street lighting of the town just yet, though it could be done at less than half the present cost, light for light. Still there is no reason why the public buildings should not have the advantage of this lovely light—no reason, for instance, why it should not illumine the Cutlers' Hall, the Albert Hall, and, more important still, the Mappin Art Gallery.

A YEAR WITH THE NEW TELEPHONE COMPANY.

THE following particulars of some of the most important private line installations completed by the New Telephone Company during the past year may prove of interest to many of our readers :—

Messrs. Fardell & Co. have been supplied with telephonic communication between their offices in the Minories and Irongate Wharf. This line, which runs through one of the busiest districts of the city, is constantly in use, and has worked excellently since its erection nearly 12 months ago. On the Bolton Corporation's line, 4½ miles in length, of which two miles are run through the sewers, the Valve telephone is reported as working most satisfactorily. At the Gloucester County Asylum and Durham County Asylum the company's instruments have been installed for joining up the various wards. On Lady Rothschild's estate at Aston Clinton the New Telephone Company's instruments continue to work well. The installation erected by the company for Lord Wantage connects Lockinge House, the estate office, agent's residence, post office, &c. A mile of the line is underground cable, and the remainder is run upon tree fixings. The London and North Western Railway has ordered Valve telephones for working on the railways in North Wales, and the Rhymney Railway Company has also been supplied with the New Telephone Company's instruments as a means of communication between signal boxes. At Mr. W. Whiteley's the company's telephone is in use for connecting some of the departments at Westbourne Grove. The business establishments of Messrs. Waterlow & Sons, Limited, in London Wall, have been supplied, and also the private residence of Mr. Charles H. Waterlow. Numerous small exchanges in factories have been erected throughout the kingdom, and the company's telephones have met with good demand from the mining districts. Messrs. Tasker Sons & Co., sole agents for the company in Sheffield and district, have secured several important installations. The introduction of the New Telephone Company's short-distance telephone has resulted in very numerous enquiries, and the brisk booking of orders for this type of instrument which has ensued would appear to indicate that there is a large field open for cheap telephones, and that they will, to a considerable extent, supplant electric bells and speaking tubes.

TELEGRAPH STATISTICS OF THE WORLD.

WE have received tables of statistics which have been carefully compiled from the *Journal Telegraphique* and other sources by Mr. E. March Webb, and which show the general state of the world's telegraphic communication up to March 31st, 1885. From these statistics it appears that the Colony of Tasmania is the best off as regards the number of offices in proportion to the population, the actual number being one office for every 991 inhabitants; Queensland comes next with one office to 1,230 inhabitants; then New Zealand with one office per 1,641 inhabitants; we then have South Australia with one office per 1,656 inhabitants: in fact, all the Colonies show up well. In European states, Switzerland heads the list with one office for every 2,287 inhabitants. In Germany the proportion is one to 3,492; France, one to 4,519; Belgium, one to 5,293; Italy, one to 9,434; Spain, one to 18,529. In Great Britain the proportion is one to 5,708; it is noticeable, however, that the latter country comes second on the list as regards the total number of instruments in use, this amounting to 18,386; Germany comes first with 19,355. The number of the staff employed in the case of Germany and Great Britain is not given; but in a previous table it was shown that the number of employés in the case of Great Britain exceeded the total number of nearly all the other countries put together.

In the United States of America the office accommodation is one to every 3,668 inhabitants, and the number of telegrams per head of population, ·77. The highest proportion in this respect is found in the Colony of Queensland, where the average is as high as 3·76; the other Colonies all come out well as regards the use made of the telegraph. France shows a proportion of ·86, which is more than double that of Germany, which gives ·40. In Great Britain the number is 1·11; but it is probable that this proportion is now largely exceeded since the introduction of the 6d. rate. It is noticeable that in Brazil the average is as low as ·02.

PRACTICAL NOTES CONCERNING THE CONSTRUCTION, USE AND MANAGEMENT OF STORAGE BATTERIES.

By A. RECKENZAUN.

(*Continued from Vol. XXI., page* 80.)

Variations of density of acid with varying temperatures.

IN tables III. and IV. (ante), and diagram, fig. 4, we have shown how the specific gravity of diluted sulphuric acid varies with the amount of charge in a storage cell. Examples were given of three cells of equal size and capacity, with acids of 1,100, 1,125 and 1,200 degrees (density) respectively, water taken as a basis at 1,000. No reference was then made to temperature effects.

Now we propose to treat this subject from another point of view, viz., to study the properties of sulphuric acid apart from electrolytic influences. All liquids vary in density with changes in temperature, and this fact has to be taken into consideration when accurate experiments with storage batteries are to be made. Tables giving the strength of various solutions have been compiled, but graphic methods of representation have an advantage over tables in so far as they render calculations unnecessary The accompanying diagram, fig. 8, has been constructed by Mr. Frederick Reckenzaun, of New York.

In this diagram the specific gravities are taken for ordinates, and the temperatures for abscissæ. Pure, concentrated sulphuric acid (1·842 s.g.), was first subjected to the test, cooled down to 0° C, and then gradually heated to 100° C, the density being carefully measured at every 5° advance of temperature, and plotted upon the diagram, producing curve A; this is practically a straight line on the uppermost part of the chart. Curve B, below, represents the variation of density of pure water. Between these extremes are plotted curves taken from diluted $H_2 S O_4$; the percentage of concentrated acid being indicated upon the standard temperature line, 15° C. Ordinarily, in secondary batteries, the densities of diluted acid vary between 1,150 and 1,230 degrees, and these have been traced on the diagram advancing 10 degrees for every division.

Dr. Otto's curve, D, also on fig. 8, has been constructed by the aid of table IX., but in this case the percentages of pure acid were taken for abscissæ, and the specific gravities, as before, for ordinates; this curve corresponds to a temperature of 15° C. Any number of similar curves may be plotted; thus, for instance, curve E corresponds to a temperature of 70° C.

The curves between, and approximately parallel to, A and B were obtained from specific gravity tests at various temperatures by Mr. Fred. Reckenzaun, and they will be found of great utility in secondary battery work. One of the advantages of these curves is, that they give a ready means of ascertaining the ultimate density of freshly diluted acid, and thus avoid waste of time occasioned by waiting until the mixture has cooled down to a given temperature, and then re-mixing until the desired standard is obtained. Supposing, for example, that diluted acid of 1,150 density is desired

at a temperature of 15° C., but that at the time of mixing the entire liquid has a temperature of 70°, then we should dilute it at that temperature until its density is 1,117 so that it will assume 1,150 when cooled down to 15° C. It will be noticed that the pure water line, B, has a greater curvature than B′ corresponding to an addition of 10 per cent. of acid, B″ is again less curved than B′ and so on, until we arrive at A which is practically a straight line.

Makers and users of secondary batteries frequently obtain the acids ready diluted to the desired standard by the acid manufacturers. This is a wise plan where weight and bulk do not materially swell the cost of transport. In many instances, however, freight forms a serious item, and then the user will have to dilute pure acid with pure water in accordance with instructions. Frequently the density of old acid has to be readjusted, and in such cases these tables and diagrams

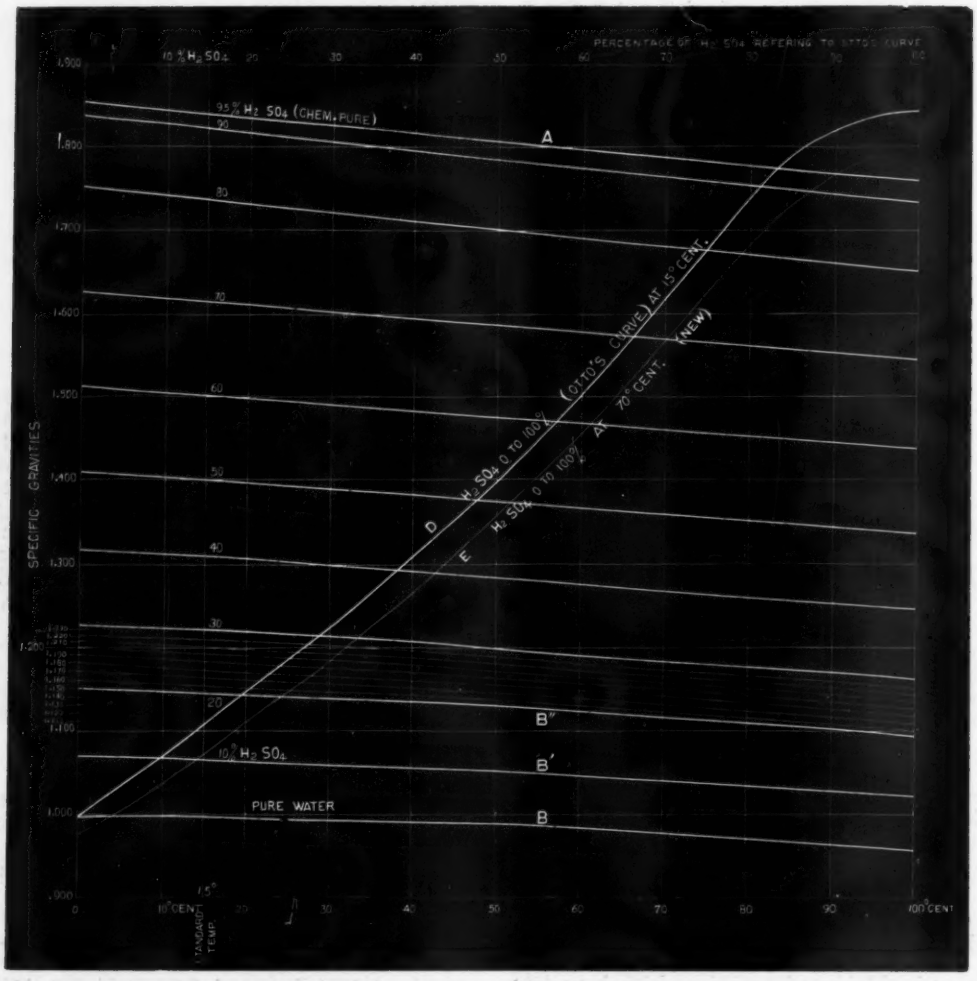


Diagram showing variation of density of sulphuric acid at various degrees of dilution under varying temperatures. (By Fred. Reckenzaun.)

TABLE IX.

Dr. Otto's table of the strength of sulphuric acid of different densities at 15° C.

Per cent. of H_2SO_4.	Specific gravity.	Per cent. of SO_3.
100	1842	81·63
40	1306	32·65
31	1231	25·3
30	1223	24·49
29	1215	23·67
28	1206	22·85
27	1198	22·03
26	1190	21·22
25	1182	20·4
24	1174	19·58
23	1167	18·77
22	1159	17·95
21	1151	17·4
20	1144	16·32
19	1136	15·51
18	1129	14·69
17	1121	13·87
16	1136	13·06
15	1106	12·24
14	1098	11·42

will be found of material assistance. Again, the usual hydrometer tests are of little value unless corrected to the temperature of the acid at the moment the tests are made. It is a common practice to take hydrometer readings and note them down for future use without the least reference to atmospheric conditions; and people wonder sometimes why the indications vary under similar treatment electrically.

(To be continued.)

American Institute of Electrical Engineers.—The American Institute of Electrical Engineers has begun, in its monthly issue of transactions, an index of current electrical literature, dating from October. The permanent value of such an index to electricians and the scientific public is apparent. The first instalment contains references to more than 300 distinct articles, cited from 18 papers and periodicals which are regularly indexed each issue, and from about 50 journals in all. Subsequent issues will comprise the leading electrical publications in foreign languages. A standing list of these periodicals, with publication address, price, &c., will also be printed when space permits.

NOTE ON THE THEORY OF THE ELECTROPHORUS.

By E. C. RIMINGTON.

IN most elementary text-books the theory of the electrophorus is explained in a manner somewhat similar to the following. The ebonite on being excited by beating with a catskin takes a certain negative charge, often known as the "inductive charge." On placing on it the brass cover there is induced on the side of the latter next to the ebonite a positive charge *nearly* equal to the negative charge on the ebonite. This is known as the "induced or bound charge." On the other side of the cover an equal positive charge is induced, called the "inductious or free charge." On connecting the brass cover to earth or to the brass plate fixed to the bottom of the ebonite (the sole), the latter charge is neutralised by the positive charge which was given to the catskin, leaving the induced positive charge on the cover in the form of a free charge.

This explanation cannot be said to be correct under the conditions which usually exist when the instrument is worked. The surface of the ebonite is beaten with the catskin, the latter being in connection by means of the hands and body of the operator with the sole. A certain − charge is produced on the ebonite and an equal + charge on the catskin; this latter will distribute itself over surrounding objects, including the sole, inversely as the resistance to induction. Now, the inductive resistance between the top surface of the ebonite and the sole is generally much less than that between the ebonite and other objects, such as the walls of the room, &c., since it is only the resistance offered by a comparatively thin layer of ebonite. Hence nearly all the + charge will be situated on the sole. We may picture to ourselves the lines of force which pass through the dielectric from the + to the − charge, as nearly all passing through the ebonite and only a few through the air. The cover is now put on; this will not practically alter the inductive resistances; so that the number of lines of force which cut the cover is very small compared with the total number, hence the induced, and consequently the inductious, charge on the cover is very small compared with the charge on the ebonite, *not* as is generally stated, *nearly equal* to it. The inductive resistance between the cover and the ebonite is caused by a *very* thin film of air and is very small compared with that between the sole and the surface of the ebonite, so that when the sole and the cover are connected together nearly all the charge in the former distributes itself over the cover, so that the charge on the latter is now nearly equal to that on the ebonite. We have in fact a condenser, of which the cover and the sole form the + coating and the top surface of the ebonite the − coating, all the lines of force starting from the former and terminating in the latter. The cover of course no longer possesses induced charges since no lines of force now cut it. On removing the cover an electric field is set up between it and the ebonite and in discharging it by touching any object in connection with the sole, the charge on it is again distributed over the sole.

The above description can be best illustrated by means of the following diagrams. The charge on the ebonite is taken as 100 and consequently the corresponding + charge is 100, of which 99 is supposed to be the charge in the sole and one that on surrounding objects.

The lines surrounding each diagram represent the walls of the room, S the sole, E the upper surface of the ebonite, C the cover. The sole is in connection with the walls of the room as shown. In (1) the lines of force nearly all pass between E and S, and only 1 per cent. between E and the walls; these latter cut C as shown in (2). In (3) C and S are connected and 98 per cent. (suppose) of the charge is distributed over C. (4) shows C raised from E. There are now two inductive circuits, one through the air from C to E, the other through the air from C to the walls and from them to S conductively, then through the ebonite from S to E. (5) is similar to (4) only that C is still nearer to the walls. (6) is when C touches the walls and we obtain a state of things similar to (1).

The fact of the induced charge on the cover of the electrophorus being much smaller than the free charge it possesses when removed can be easily shown experimentally by the aid of a gold leaf electroscope.

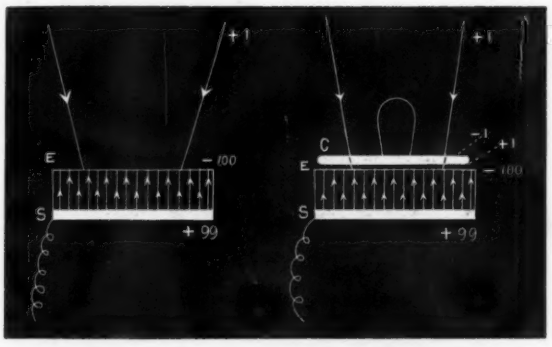


FIG. 1.

FIG. 2.

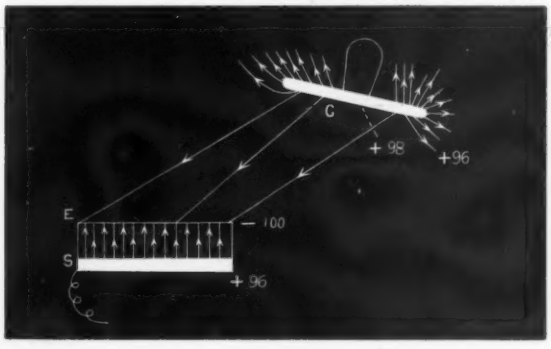


FIG. 5.

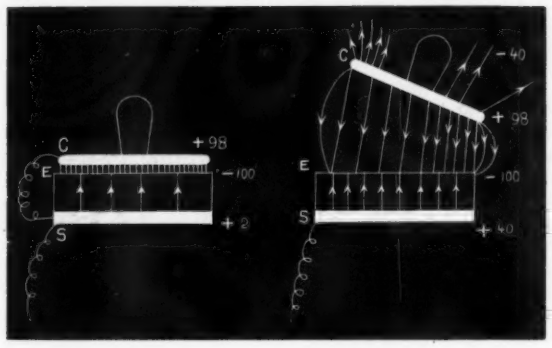


FIG. 3.

FIG. 4.

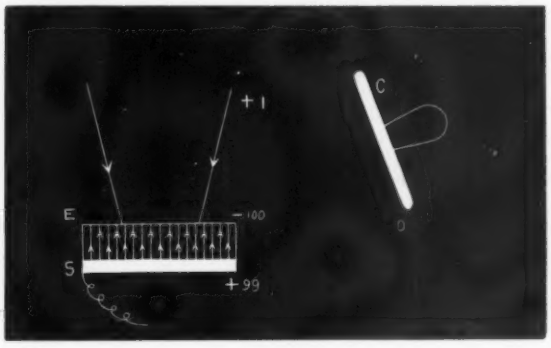


FIG. 6.

Excite the ebonite in the usual way and place it on the top of the electroscope as shown in fig. 7; the brass plate of the electroscope now forms the cover of the electrophorus; a slight divergence of the gold leaves will take place, due to the inductious charge.

Now, connect S and C together, fig. 8: the gold leaves will at once collapse. On breaking the connection and

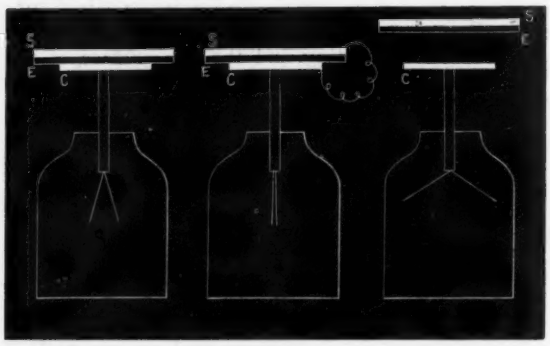


FIG. 7. FIG. 8. FIG. 9.

removing the ebonite they will again diverge, but to a much greater extent than before, as in fig. 9, this divergence being due to the free charge on C.

Fig. 7 corresponds to fig. 2, fig. 8 to fig. 3 and fig. 9 to figs. 4 and 5.

SINGLE FLUID BATTERY.

THE battery here illustrated is described in the *Scientific American*, by Dr. T. O'Conor Sloane as a very efficient and simple form for open or closed circuit work. It represents a favourite and recent type for such cells, and can be put together with the minimum number of tools and appliances.

The cover is made of wood. If a circular vessel is used, the cover should be cut in a circle equal in diameter to the outside of the jar, and a shoulder should be formed to hold it in place and prevent lateral motion. Any number of holes, according to the size, are bored through it, one set for the reception of the carbons and the others for the zincs. Care should be taken to bore these holes truly vertical to the plane of the cover, and the bit used should make a hole of exactly the right size to fit the carbons and zincs respectively. The fit must be a very tight one, so that the rods have to be driven into their places with a mallet or hammer.

For the positive elements, zinc rods, such as sold for the Leclanché battery, are used. Such rods can be bought of 6 or 8 feet in length and of uniform diameter. Pieces are cut off of the proper length, a cold chisel, hack saw, or file being used. A very easy way of dividing the rod is with mercury. A fine groove is filed around it A globule of mercury is placed in a saucer with a little dilute sulphuric acid. A thin slip of zinc or a strip of galvanized iron is dipped in the mercury. Some adheres to it. This is then drawn around the cut, so as to fill it with mercury and amalgam. Then the rod is broken off, either in the hand or in a vise. It becomes almost as brittle as a pipe stem. This process is hardly to be recommended for the upper ends of the zincs. These have to be soldered, and the mercury interferes with the operation to some extent.

For negative elements, electric light carbons are used. The copper is dissolved off by nitric acid, they are washed, dried, cut to the proper length by a saw or cold chisel, and their upper ends are soaked in hot paraffine.

Both elements are now driven into their respective places. With each carbon a slip of copper ¼ inch wide is also introduced, and lies alongside, pressed hard against it and projecting about as much below the cover. As shown in the cut, a wire is carried around the outer circle of the carbons, and is soldered to the copper strips. If a central carbon has been used, as shown, a special connection is soldered to it and to the main wire. The end of the wire is carried up through a hole in the cover. A second wire is soldered to the zincs, this piece lying on the upper surface of the cover. Concentrated hydrochloric acid (muriatic acid) is the best flux for the zincs. If desired, the projecting end of the zinc connection may be secured to the wood by a staple. This is not necessary if the soldering is solid.

To amalgamate the zincs, a strip of galvanised iron is far the best instrument. The end of such a piece, which may be 2 inches by ½ inch, is bent into a hook, so as to fit the zinc rods. This is dipped into the globule of mercury as it lies under a little dilute acid, and is rubbed up and down the rods. If the mercury does not take hold at once, the zincs and carbons may be dipped nearly to the level of the cover in dilute sulphuric acid. After a few minutes' immersion the zinc will be ready to amalgate, and the rods will shine like silver after a few minutes' rubbing with the galvanised iron and mercury.

The soldering may of course be dispensed with. Instead of strips of copper, the ends of some pieces of wire may be flattened and driven into the holes along with the carbons and zincs. By twisting together the ends of these, zinc connections and copper connections separately, the battery will work perfectly if care is taken to avoid short-circuiting. When it is made in a hurry, for temporary use only, the paraffining of the carbons may be dispensed with, and the copper may be left upon their upper ends. The wires may be soldered directly to this, although such connection is rather weak.

For bichromate solution, 2½ oz. of bichromate of potash in fine powder are shaken up in 10 fl. oz. of water. To this 2¼ fl. oz. of sulphuric acid are added slowly with constant stirring. Great care should be taken in pulverising the bichromate of potash, as it causes ulcers if inhaled. For open circuit work a solution of sal ammoniac may be used. The ends of burned-out carbons such as are thrown away by the lamp attendants answer perfectly for the smaller sizes of this battery.

Fire Alarms Saving Life.—The Western Electric Company of Chicago has received a very complimentary letter from Mr. J. L. Griswold, proprietor of the Saratoga Hotel, St. Louis, where a serious fire recently occurred. The writer speaks in flattering terms of the excellency of the fire alarm and guest call put in by the above company, by means of which many lives were saved at a recent fire.

TESTS OF THE JULIEN ACCUMULATOR.

THE following electrical measurements of the Julien accumulator were made, writes Mr. George B. Prescott, jun., in the *Electrician and Electrical Engineer*, in order to determine its adaptability to a certain class of work, and to that end it has been sought to ascertain with as much accuracy as possible its precise rate of doing work, the total amount which it is capable of performing, and its efficiency under various conditions, as a transformer of energy. For this purpose I employed five of the standard cells of the following dimensions, as determined by my own measurements, viz. :—

Weight of cell complete	38 lbs.
„ grids and active material	27·5 lbs.
„ electrolyte	4·5 „
„ glass containing jar	6 „
Number of positive plates	9
Dimensions „ „	$5\frac{13}{16} \times 5\frac{13}{16}$ lbs.
Active surface of positive plates	4·25 sq. feet.

Three of the above cells were furnished directly from the works, especially for this test, and the remaining two were received from the works at the same time by Mr. Weston. These latter were incorporated into this test as it was deemed that greater accuracy could be attained by the use of a larger number of cells. It is assumed, of course, that all were thoroughly formed and in prime condition.

Three of the cells were filled with dilute sulphuric acid (free from nitric acid), of the density of 15° Baumé ; the electrolyte of the remaining two cells had a density of 23° Baumé. The degree of density of the electrolyte had no perceptible influence upon the E.M.F. of the accumulators, and the conditions of the test were such as to make it inconvenient to determine whether the regularity of discharge was influenced by this condition.

The cells were charged by a Weston dynamo driven at a uniform speed, and were discharged through German silver wires adjusted to suit the required conditions. E.M.F. and potential difference (P.D.) were measured by means of a "White" pattern Thomson quadrant electrometer, standardised by Weston-Clark standard elements. All readings are given in legal units, and time was accurately noted. Current was measured by a magnet ammeter, reading to within two-tenths ampère, which was carefully calibrated at the beginning of the test.

The cells were never discharged at a rate exceeding 30 ampères, as that was the limit of reliable reading on the ammeter ; but the general results are such as to indicate that the normal out-put of these cells should not be allowed to exceed that rate if anything like a reasonable efficiency is desired. No doubt this out-put may be momentarily increased up to 40 or 50 ampères without immediately endangering the stability of the cell, but such increase will always be obtained at a large sacrifice of its efficiency.

Five complete tests—charge and discharge—were made, and the general results are recapitulated in the table. The significance of these figures is so obvious that I hardly need to point out the general conclusions to be drawn therefrom.

The first charge was discontinued about one-half hour after gas began to be freely evolved from the cells, and the rate of charging was approximately that given by the makers, viz., 18 ampères. The discharge was maintained at about 20 ampères, and the test showed a return of nearly 70 per cent of the total energy absorbed. The second and third tests were also made at the normal rate of charging, which was, however, carried to a higher point than in the first test, and continued for a longer period after gas began to be evolved. They were discharged at the rate of about 30 ampères, and while a somewhat greater out-put was shown over the preceding tests, the energy returned fell off to 61 per cent. In the fourth test the charging was accomplished at the normal rate, but was continued for several hours after the evolution of gas, and until nearly 400 watt hours of energy had been expended in each cell. The total output thereby obtained did not, however, exceed that of the preceding tests in which much less work had been done in charging—the efficiency falling to 54 per cent.—thereby clearly indicating that the limit of charge is not much over 300 watt hours per cell. The output might be slightly increased by increasing this charge at a low rate, but under the necessary practical conditions of quick charging, any increase would be obtained at such an enormous loss that it would be, commercially, out of the question.

The fifth and last test was carried out without special regard to makers' instructions, although, with the exception that the density of the current was greater, the general effects were about the same as if the cells had been charged at constant potential. The charging current was kept at 26 ampères until there was a mild evolution of hydrogen, and then gradually decreased so as to maintain the evolution of gas about constant. When the current had thus been reduced to 10 ampères it was allowed to stand at that strength until the gas began to be freely evolved, when the charge—according to my belief—having reached its economical limit, was discontinued. The evolution of gas represents the expenditure of energy, and as it is dissipated beyond the reach of recovery such evolution means direct loss, and the charge cannot be carried beyond that point without a corresponding loss in the efficiency of conversion. I have not seen this point noted in any of the numerous papers on accumulators which I have read, but I assume that it must be obvious to everyone. The high efficiency of 95 per cent shown by this last test is chiefly due to the low rate of discharge, which never exceeded 10 ampères, but was largely increased by the discontinuance of the charge at 260 watt hours before the loss of much gas. It was, no doubt, still further raised by the cells having recovered somewhat from the previous discharge, which had been effected at a high rate, and thus an abnormally large output was obtained although discharged to the same potential in both cases. That is to say, when the cells are discharged at a high rate their potential falls suddenly to the normal limit. When discharged slowly the potential falls gradually to the limit. In the former case, after remaining open for a while, there is considerable recovery, whilst in the latter case there is hardly any. Therefore, it would appear that the efficiency given for test No. 5 is higher than its true efficiency, owing to an excess of residual charge that could not easily be allowed for.

The effect of lapse of time between the charging and discharging of the accumulators could not be accurately determined without extending the tests for a considerably longer period of time. The difference in loss of efficiency between an immediate discharge and one after the lapse of 15 or 20 hours is, however, very small, although if the cells are not thoroughly insulated, it might amount to something considerable.

From the figures of the tests and the preceding considerations it is obvious that almost any degree of efficiency may be obtained from these accumulators. In fact, it is well known that the maximum efficiency of any accumulator is attained when the rate of charging and of discharging is a minimum ; in other words, when the power expended or rate of doing work is a minimum. It is therefore necessary to adopt some standard working rate for these cells, and then determine their capacity and efficiency on the basis of this rate of working. The normal output of the cells should not—as already determined—exceed 30 ampères, and as the average E.M.F. of the cells is about two volts, it is obvious that the average rate of working must not exceed 60 watts per cell. At this rate the capacity of the cells will not exceed 110 ampère-hours, and as the average P.D. during discharge is 2·03 volts, the total work done by each cell will not exceed 225 watt-hours.

Again, considering the figures of the tests, and taking into account the system of working the accumulators, their efficiency at the above rate of working will be somewhat between 60 per cent. and 70 per cent. For ordinary working on the assumption

that abnormally large discharges will be balanced in effect by abnormally small ones, the efficiency of the accumulators will probably closely average 65 per cent., and I think this figure a safe one to estimate upon.

On the above basis the following figures are self-explanatory :—

FOR A SINGLE CELL.

Rate of working	0·0804	H.P.
Time of working at this rate	5·75	hours.
Total work	0·3016	H.P.
Battery per H.P. hour	126·	lbs.

Thus 38 cells will weigh 1,444 pounds, and will develop 11·46 H.P. hours, which, expended at the rate of 60 watts per cell, is equal to 3 H.P. for 3·82 hours. Any loss in secondary conversion must, of course, be deducted from these values.

RECAPITULATION OF FIVE TESTS.

Test No.	Charge or discharge.	Time. Hours.	Mean P.D. at cells. Volts.	Rate. C Ampères.	Rate. C E Watts.	Total. $C t$ Ampère hours.	Total. $C E t$ Watt hours.	$\frac{C_1 E_1 t_1}{C E t}$ per cent.	$\frac{C_1 t_1}{C t}$ per cent.	$\frac{C_1}{C}$ per cent.	Fall in potential per cent.	Time between charge and discharge. Hours.
1	Charge	6·25	11·76	17·6	205·3	110	1283					
1	Discharge	4·59	10·12	19·23	194·6	88·3	893·7	69·7	80·3	109·3	9	15
2	Charge	8·17	11·9	18·07	215	147·7	1756·8					Interv. of 14 hours.
2	Discharge	3·72	10·09	28·86	291·2	107·3	1083·2	61·7	72·6	159·7	8	2 + 15
3	Charge	8	12·13	18·08	219·4	144·6	1755·2					
3	Discharge	3·55	10·14	29·47	299	104·6	1060·8	60·5	72·3	163	11	16
4	Charge	9	12	18·01	216·2	162·9	1955·3					
4	Discharge	3·53	10·13	29·8	301·9	105·13	1065·8	54·5	64·3	165·4	15	15½
5	Charge	5·11	11·58	22·1	255·9	112·75	1305·8					
5	Discharge	11·83	10·3	10·23	105·3	121·15	1247·7	95·5	107	46·3	8·3	15¾

$\frac{C_1 E_1 t_1}{C E t}$ Ratio of work delivered to work absorbed.

$\frac{C_1 t_1}{C t}$ Ratio of current delivered to current absorbed.

$\frac{C_1}{C}$ Ratio of discharge current to charging current.

Reduction in potential during discharge.

The minimum reduction in potential during discharge was 8 per cent., the maximum 15 per cent.

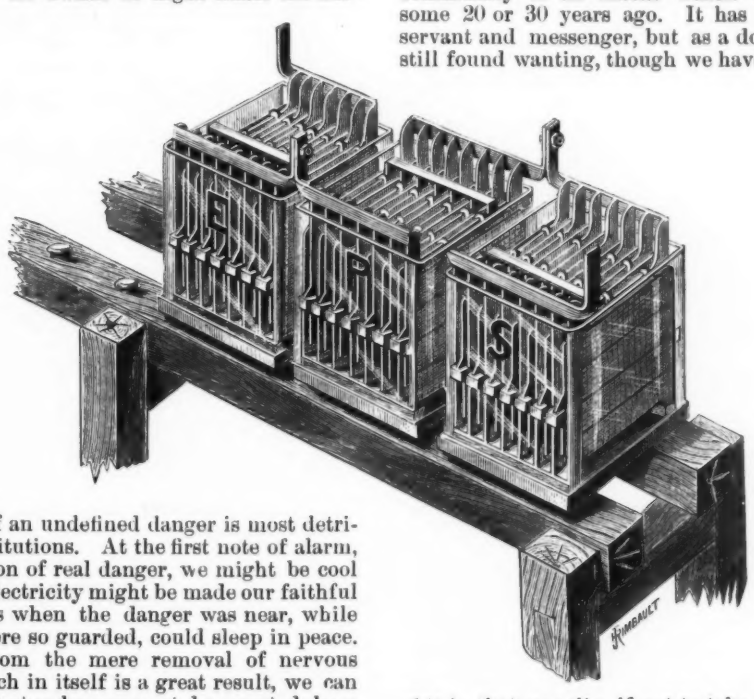
As to the permanency of the cells, both as regards mechanical durability and electrical efficiency, time alone can report.

ELECTRICAL APPLIANCES IN OUR HOUSES.

IT is somewhat strange that with all our wealth of electrical appliances, with all the numerous and beautiful instruments that have been devised for telegraphic purposes, not to mention the more recent inventions in connection with the telephone and the electric light, electricity has been pressed into our service for domestic purposes to a very limited extent. It will be a red-letter day in the history of this country when the electric light comes within the reach of those who have now to be content to burn gas, oil, or candles. What an abominable flavour these three words have as we rapidly realise all the obnoxiousness, the danger, the waste of nervous force which they entail upon us. We live in constant dread of the spot of candle grease on the floor, of the upsetting of the oil lamp, or of being blown out of the window owing to the fatal propensity which some beings have of endeavouring to detect an escape of gas by means of a naked light ; or, at least, if we do not live in constant and conscious dread of these and other similar disasters, they none the less exist, and unconsciously we are subject to their terrorising influence. Then think of all the subsidiary evils which the use of these necessitates. We must have our box of matches handy—as often as not they have to be found in the dark—we must see that the supply of candles or oil does not run short, and though the gas is handier in this respect, yet our mind is constantly exercised as to the veracity of the meter. Our ceilings are blackened, our globes cracked, our burners defective, the gas jumps or roars, or does not give sufficient light, and to crown all, we suffer in health, and are such creatures as to breathe without a murmur the vitiated atmosphere, and even give no thought to the immediate cause of the headache or lassitude which may become our nightly companion. It would seem, however, as if we should have to wait many a long year as yet before this state of things will become the exception instead of the rule, albeit we can now look forward with certainty to the final triumph of electricity as an illuminating agent. The difficulties in the way are well understood, and are being resolutely and successfully attacked. To provide every district, every street, and every house with a sufficient, constant, and economical supply of electricity is only a question of time, and meanwhile many attempts have been made to find a short cut to the desired end ; but none hitherto with any great amount of practical success. The primary battery has called forth an enormous and astonishing amount of inventive genius, for which all due credit must be given ; but we should be bold to assert that there is any chance of the great desideratum being attained by this means.

It is, of course, quite possible that some inventor who has been quietly working on new and, perhaps, unsuspected lines, may shortly come forward with a discovery which will enable us to obtain a supply of electricity from sources which lie ready to our hand, and which may be utilised without our going outside our own doors. All this, however, is matter for speculation ; but meanwhile it would appear that we do not avail ourselves of advantages and appliances which, though they may be regarded as small things in comparison with the application of electricity for lighting purposes or for motive power, are yet capable of doing us great service in relieving us of many of the minor worries which in their sum total have a considerable influence on our lives. We do not rightly appreciate the influence of small worries, little anxieties, and constant, though perhaps unconscious, apprehensions to which we are daily subjected. There is a waste of tissue and a mental effect in these which we may be so deadened as not to notice even in their cumulative results. With the philosophical mind which rises superior to everyday events we are not now concerned ; the majority of us are sadly liable to be put out of temper on very small provocation, and anything that can ameliorate our condition and make us less liable to external disturbing influences should be welcome. Take, for instance, the protection against burglars or fire that can easily be given by a simple electrical apparatus. The want of such a protection, even to persons who are not nervous, may cause a good deal of disturbance in the small hours of the night, when some suspicious noise may arouse the sleeper, and cause him to strain his faculties to account for it. How many people we find who are extremely nervous about burglars, or

perhaps still more so about fire, and who have to confess that their sleep is often disturbed by their apprehensions. Nothing is easier, as our houses are now built, than for a burglar to effect an entrance, while, on the other hand, a very small outlay would render it impossible for him to do so without being detected; and our houses might be equally well protected against a fire gaining any considerable hold before being discovered. We do not say that this could be done effectually and simply by means of the apparatus usually sold for this purpose. It is probably the want of reliable apparatus, or, at all events, the want of some apparatus which will inspire the householder with confidence in his ability to work it, that accounts for the very limited use to which electricity has been put for this purpose. But surely there is a large field here both for inventive genius and commercial enterprise. Looking at the variety of instruments, for instance, which are in use for telegraphic and railway purposes, and the great number of operations they are made to perform, it does seem astonishing that we make use to such a small extent of electrical apparatus for the purpose of safe-guarding our property. While we are striving to do the big thing with the electric light we are leaving the smaller but quite as important thing undone. To lie awake at night under the nervous imagination of an undefined danger is most detrimental to our constitutions. At the first note of alarm, or the first realisation of real danger, we might be cool and collected, and electricity might be made our faithful servant to arouse us when the danger was near, while we, knowing we were so guarded, could sleep in peace. Apart, however, from the mere removal of nervous apprehensions, which in itself is a great result, we can never tell what catastrophe may not be averted by a timely warning. By safe-guarding our houses in this way we should be effecting an insurance both on our lives and our property.



Again, in the matter of electric bells and indicators, there is much that might be achieved. Electricity is capable of doing more than merely replacing the old mechanical bell pull, and even this it has done to a very limited extent. The more modern built houses are for the most part fitted with electric bells, but on the old lines. The pushes are fixed against the wall in the old positions instead of being handy for use in any part of the room, at the table or the bed, or where they are most frequently required, while very little, if anything, has been attempted in a practical way towards indicating the purpose for which the bell has been rung.

By another piece of apparatus, moreover, the lady of the house might keep a check on the doings of the servants below stairs. Outer doors and garden gates may be automatically locked, so as only to be opened by means of electrical communication from the house, whilst an indicator would show when they were properly closed, or when they were open.

On a small scale the electric light is also available for many purposes which would relieve us oftentimes of much inconvenience and discomfort. With a small battery of Leclanché cells and an incandescent lamp of one or two candle-power, we have the means of producing a light which can be placed at the bed head so as to be available at any time of the night by merely putting out our hand to turn the switch, or which can be utilised in various parts of the house for occasional puposes, where we should otherwise have to rummage in the first place for matches in order to produce a light.

These and many other electrical labour-saving appliances should be brought within reach of every householder. Anything that enables us to live with less friction, with less wear and tear, that makes us less liable to accident, to external disturbing influences and dangerous forces, is hailed as a boon to our civilisation; and electricity is capable of playing a much more prominent part, of taking a much larger share in our domestic economy than it at present obtains. For this purpose we require new and improved apparatus, and a spirit of enterprise to make their use more widely known and appreciated.

Electricity has been pressed into the service of the community to an extent which was hardly realised some 20 or 30 years ago. It has become our public servant and messenger, but as a domestic servant it is still found wanting, though we have an increasing need of it in that capacity, if not to take the place of, at least to serve as a check upon those incapable and unreliable beings who are supposed to administer to our comfort, but who oftener do so to our discomfort.

THE "1888" TYPE "E.P.S." ACCUMULATOR.

AN entirely new form of construction mechanically will characterise the cells that will be supplied by the Electrical Power Storage Company after January 31st. The use of India rubber bands, glass slabs, and similar devices for binding and supporting the plates is entirely abandoned. The plates are so arranged that there is no possibility of internal short circuits caused by the lodgment of plates or pellets of oxide or powdered paste at the bottom of the cells.

By an exceedingly ingenious device the opposite electrodes of the plate sections can, when necessary, be taken apart in a few minutes, and the peroxide plates removed *en bloc* without disturbing the spongy lead plates, and can be replaced with equal rapidity and certainty. By supplying a greater quantity of elec-

trolyte, free circulation of the acid is obtained, while the rise and fall in specific gravity is correspondingly less, and the output and capacity for increased rates of discharge is very considerably increased.

The hard alloy grids adopted some twelve months ago, have given the greatest satisfaction under very severe tests, so that with the above-mentioned improvements, the perfected E.P.S. battery should prove a great inducement to the formation, development, and ultimate success of central station lighting companies, while the increased durability and ease of attention should favourably affect the progress of electric lighting of mansions, private houses, ships, factories, &c.

It is proposed to extend the before-mentioned arrangements, together with others to meet the special requirements of the case, to cells intended for traction and other motive power purposes; the results of experiments up to the present having shown considerable advances in the capacity to withstand the disruptive effect of very high rates of discharge.

AMERICAN NOTES.

By "DAS TELEPHON."

In matters electrical in the United States three subjects are now being discussed by those interested therein; and the subject which, from its scope, would seem to be the most important, is the establishment of a "Postal Telegraph" by the U.S. Government. Three bills relating thereto have been introduced into the Senate and referred for consideration to the "Committee on Public Offices." This is not the first time this matter has been agitated in Congress. In 1871, G. G. Hubbard, father-in-law of Prof. A. G. Bell and a ten times millionaire *at present*, had a bill introduced into the House of Representatives for the purpose of chartering a company with full powers to construct telegraph lines and to do all the telegraph business. The committee devoted many long sessions to the consideration of this measure. It was opposed by the Western Union Telegraph Company—with its sixty millions of capital (forty of which is water). The committee made a long report, which was printed by order of Congress, and that was the only result of the investigation. It was said that the weight of the money bags, water included, of the Western Union was very much greater than that of Hubbard and his supporters; and *self-interest* asked what good reason could be urged upon a Member of Congress to abolish the Western Union Telegraph Company, so long as the Members of Congress had *free* use of the lines of that "Octopus," to which name it is entitled by virtue of its absorption of all the telegraph companies which have attempted to run in opposition to it. There seems to be a consensus of opinion throughout the States against a Government telegraph on the ground that it will add some 50,000 employés, all voters, to be used for electioneering purposes by the Administration. I shall obtain copies of the bills, and send you a synopsis of them—if I find any feature in them worthy of notice.

Another subject, the revision of the Patent Laws, is being agitated by the National Electric Light Association. The attorney of the association read a paper on this subject a few days ago before the American Institute of Electrical Engineers, and invited co-operation in aiding the enactment of a law by Congress for that purpose. The bill proposed by the Electric Light Association was read and discussed. The general opinion seemed to be adverse to the proposed law. It was admitted by all that a few alterations in the present law are desirable, and might be obtained from Congress, but it was found that an attempt to procure the radical changes contemplated by the proposed bill might be injurious, and perhaps lead to the abolition of all the patent laws. Several attempts have heretofore been made to repeal the patent laws, and have come very close to being successful.

One of the clauses of the proposed bill is to devote all the receipts of the Patent Office (about 100,000 dollars a year) to the use of the office—in increasing the salaries of the principal examiners, and in providing more room for them. The increase of the salary of these employés is urged by all those who have any business with the Patent Office, because of the absence generally of knowledge by the examiners of subjects for patents brought before them. The present salary is 2,250 dollars.

As an example of the scientific attainments of a late Examiner of electrical applications, I state, as a fact, that he objected to an application for a patent for a telephone receiver, giving as his reason therefor, "That the substitution of a wooden disc for an iron disc was obvious." Your readers may exclaim, "*Eredat Judæas*," but I have in my possession the written statement of that Examiner. There is one instance of the Examiner of "water shoot apparatus" being transferred to be "Principal Examiner" in the Electrical Department.

One of the changes proposed relates to what is known in the Patent Office as "Reissues," and to me this change suggests what is here termed "a nigger in the fence." The following is the rule regarding "Reissues":—

"84. A reissue is granted to the original patentee, his legal representatives, or the assignees of the entire interest, when, by reason of a defective or insufficient specification, or by reason of the patentee claiming as his invention or discovery more than he had a right to claim as new, the original patent is inoperative or invalid."

It is well known that under the operation of this rule patents have been extended many years after the expiration of the original patent under certain restrictions, as follows:—

"89. In cases of application for reissue, an original claim, if reproduced in the amended specification, is subject to re-examination, and the entire application will be revised and restricted in the same manner as original applications."

It is possible that certain companies fear to make application for reissues, but under the above rule they lose their original patent, and hence this rule is to be abolished.

The third electrical matter now agitated in New York is the affairs of the subway. At a recent meeting of the Board of Electrical Control a long list of streets where the subway has been laid was read, and the companies having wires in those streets were ordered to use the subway and remove their poles and wires within 90 days. The Mayor was also requested to direct the Commissioner of Public Works to remove the poles and wires in certain other streets where the conduit has been completed for ninety days, and where the companies, after due notice, have neglected to put their wires under ground. The Mayor said he would consider the resolution. If he issues the order and the companies resist its execution, the matter will be carried into the courts, and the biggest kind of a fight between the electrical companies and the subway company will follow.

Your readers I suppose know how the subway is constructed. I predict the failure of the system, for the simple reason that telephones cannot be operated on wires which run parallel 6 inches apart from telegraph wires.

The U. S. Supreme Court has not yet given its decision in the Bell telephone case. It will probably be given in the latter part of January, after the holidays. Bell stock in 15 days fell from $230 to $198. I believe the Bell patent will be sustained by the Court.

Daniel Drawbaugh, one of the inventors of the telephone, is now at work on an invention by which the presence of large bodies of men on land and ships on the ocean can be detected. It is an electrical machine, and Drawbaugh claims that a general with this new contrivance in his tent can tell by its peculiar motion if the enemy is near and prepare to give him a warm reception. The commander of a war vessel can also tell the approach of any vessel, hostile or otherwise, the resistance of the water on the approaching vessel causing sufficient friction to establish a current that will cause the indicator to sound the alarm. Drawbaugh refers to his latest discovery as an "electrical paradox." It hasn't any name yet, although a portion of it has already been patented and the entire arrangement has been sent to New York City for inspection.

The practical working of the instrument is intended to do away almost entirely with the picket lines of an army.

A telephone subscriber in this city pays the company $150 a year. This is the rate for about 90 per cent. of the company's patrons. The company's officers laid before the Assembly committee annual reports and other papers showing that the net earnings per subscriber had been $132 in 1885, $127 in 1886, and $114 in 1887. In other words, of the $150 paid by the average subscriber in 1885 only $18 was required to pay his telephone's share of the company's expenses, while the remaining $132 was clear profit. In the following year the part of the rent required to pay the cost of the service was $23, and in 1887 it was $36, the profits in one case having been 80 per cent. of the receipts and in the other 76.

The Western Union Telegraph Company has declared a quarterly dividend of 1¼ per cent., payable January 16th, which is at the rate of 5 per cent. a year. In the quarterly report submitted by Dr. Green, the president, the income for the quarter ending December 31st is estimated at $1,500,000—$500,000 more than the estimated income for the corresponding quarter of 1886. The net income for the last quarter ending September 30th was $1,306,211. This was nearly $100,000 less than it had been estimated, but the surplus, October 1st, 1887, nevertheless, was $7,354,569, against a surplus, July 1st, of $7,002,185. Adding the estimated quarterly net income of $1,500,000 to the surplus, October 1st, of $7,354,569 and deducting interest on bonds and sinking fund, the balance is $8,711,919.35. Paying the 1¼ per cent. dividend out of this, the estimated surplus, January 1st, 1888, is $7,634,575.60. There is some rumour of a 1¼ per cent. quarterly or full 6 per cent. dividend for 1888. The report states that the gross revenue for the current quarter will be the largest in the history of the company, but that little reduction could be made before the 1st of December, and it will require a little further time to realise the full benefit of the economies of the consolidation.

Electric Lighting of Buoys.—Lieut. Willis, of the United States Lighthouse Department, has been carrying out successful experiments in connection with the electric lighting of spar buoys by means of glow lamps fed from cables laid from the shore.

ELECTRIC TRAMWAYS IN AMERICA.

THE *Electrician and Electrical Engineer* gives the following list of electrically-worked tram lines now in actual operation in the States :—

Town.	Line.	Conductors.	Length of line.	System.
Appleton, Wis.	Appleton Electric Street Railway	Overhead	4½ miles	Van Depoele, 5 motor cars.
Asbury Park, N.J. ...	Lea Shore Electric Railway	,,	4 ,,	Daft.
Baltimore, M. D. ...	Union Passenger Railway Company	,,	...	Daft.
Bellevue, Pa.	... ...	...	⅛ ,,	
Binghamton, N. Y. ...	Washington Street and State Asylum Electric Railroad	Overhead	5½ ,,	Van Depoele.
Denver, Col.	Denver Tramway Company	Conduit	4 ,,	Short-Nesmith, series.
Detroit, Mich.	Detroit Electric Railway Company	Overhead	2 ,,	Van Depoele, 4 motor cars.
,, ,, ...	Highland Park Railway Company	,,	3 ,,	,, ,, 2 ,, ,,
Gratiot, Mich.	Gratiot Electric Railway Company	,,	...	,, ,, 1 motor car.
Ithaca, N. Y.	Ithaca Street Railway Company	,,	...	Daft.
Kansas City, Mo. ...	Kansas City Electric Railway Company	...	...	Henry.
Lima, O.	Lima Street Railway Motor and Power Company	Overhead	6¼ ,,	Van Depoele, 7 motor cars.
Los Angeles, Cal. ...	Los Angeles Electric Railway Company	,,	5 ,,	Daft, 4 motor cars.
Mansfield, O.	... ...	,,	...	Daft.
Montgomery, Ala. ...	Capital City Electric Street Railway Company	,,	11 ,,	Van Depoele, 20 motor cars.
Port Huron, Mich. ...	Port Huron Electric Railway Company	,,	2¾ ,,	,, ,, 3 ,, ,,
Richmond, Va.	Richmond Union Passenger Railway	,,	...	Sprague motors.
St. Catherine's, Ont ...	... ...	,,	6 ,,	Van Depoele.
Scranton, Pa.	Scranton Suburban Railway Company	,,	2½ ,,	Van Depoele, 3 motor cars.
Wichita, Kan.	Wichita Riverside and Suburban Railway Company ...	,,	4 ,,	... 6 ,, ,,
Windsor, Can.	Windsor and Walkerville Electric Railway Company ...	,,	1¼ ,,	Van Depoele, 1 motor car.
Woonsocket, R. I. ...	Woonsocket Street Railway Company	,,	...	... ...

ITALIAN CABLES.

THE terms of the contract entered into between the Italian Government and the firm of Pirelli & Co. do not seem very advantageous to the latter.

The manufacture and laying of the cables, and the building of a steamer, which shall serve as a despatch boat as well as a cable ship, are at the cost of the contractor, and at the expiration of the contract the cables and ship become the property of the Government without further payment. When not required for cable work the ship will be at the entire disposition of the Government. The cost of maintaining the ship in an efficient condition, and all expenses as to officers and crew (who are Government servants), coal, provisions, &c., will devolve upon the Government. The contractor cannot obtain possession of the ship for cable work unless at least 20 days' previous notice is given to the authorities.

In consideration, the Government grants the firm of Pirelli and Co. a yearly subsidy of 222,144 francs apportioned as follows :—

For the cable between—

Naples and Ustica	91,104	francs.
Ustica and Palermo	18,096	,,
Mazarra and Pantelleria ...	34,944	,,
Lipari and Panaria	5,928	,,
Panaria and Stromboli	5,928	,,
Ponza and Ventotente	13,416	,,
Livorno and Gorzona	11,232	,,
Elba and Capraia	11,544	,,
Elba and Pianosa	4,680	,,
Gizlio and Monteargentario ...	4,992	,,
Ponza and Montecirceo	11,232	,,
Tremiti and Montemiletto ...	8,112	,,
Vulcano and Lipari	936	,,

The contract is binding for the period of 20 years.

ELECTRICAL TRAMCAR FOR AUSTRALIA.

ON Wednesday, at Wolverhampton, a trial was made with a new electrical tramcar which is being sent out by Messrs. Elwell-Parker, Limited, to the Australasian Electric Tramway Company, Sydney. The experimental runs, which extended over four hours, were made under the superintendence of Mr. Bullimore, who is appointed electrician to the Tramway Company, and sails for Australia on the 22nd, previous to which the car and its electrical equipment will be packed and shipped. The party present at the trial included Mr. Joseph Moseley (chairman of Elwell-Parker, Limited), Mr. Walker (deputy-chairman of the Manchester Tramway Company), Mr. McGill (managing director of the Manchester Tramway Company), Mr. Broadbent (managing director of the Blackpool Tramway Company), Mr. James Oddie (of the School of Mines, Ballarat), Mr. Stimson (manager of the Wolverhampton Tramway Company), two gentlemen representing the Borough Surveyor of Birmingham, and three gentlemen interested in the Tramway Company of Bilbao, Spain. The car itself has been built in a substantial manner by the Midland Railway Carriage and Wagon Company, of Shrewsbury, and is constructed to carry 60 passengers. An Elwell-Parker motor capable of giving 25 H.P. at 500 revolutions and weighing about 16 cwt. is fixed in the usual position below the flooring of the car, and the accumulators are packed below the seats, the outside panels working on hinges to allow of the placing and displacing of the boxes, of which there are 20 on each side. The principal distinguishing feature of the arrangements of this car is the absence of gearing, motion being transmitted from the spindle of the motor to the axles of the wheels on one side of the car by two chains one to each wheel, and therefore working in opposite directions, thus securing steadiness. The total weight of car, motor and accumulators is about 5 tons. The performance of the car was thought to be in every way satisfactory, though the road (as admitted by the representative of the local tramway company who was present) was in bad condition, and there were inclines of 1 in 15 and 1 in 10, as well as some bad curves. Considering that the order for this car was taken not more than six weeks ago, Messrs. Elwell-Parker are to be congratulated on the expedition and success with which the work has been carried out, and we hope this demonstration of the practicability of electrical traction may result in its early adoption by the important companies whose representatives were present.

NOTES.

Lighting of Theatres.—The Grand Theatre is to be immediately rebuilt and opened on Easter Monday, when the theatre will be entirely lighted by electricity.

The installation at the Vienna Opera has been thoroughly examined and found in perfect order by two officers of the Vienna Technological Museum.

The Alhambra Theatre, in Antwerp, was destroyed by fire on the 1st. inst. Fortunately no lives were lost.

The Bolton Theatre Royal was destroyed by fire on the 4th inst. Again, fortunately no lives were lost.

The electric lighting of the Court Theatre at Vienna is now undergoing examination by Prof. von Waltenhofen, the insulation resistance of the circuits receiving particular attention.

On December 20th., the theatre at Nancy was successfully lighted by electricity, but two days afterwards the house was plunged into darkness in the middle of a performance. The engineer in charge of the machines, finding that a dynamo was becoming heated, poured a bucketfull of water over it!

Electricity has now entirely superseded gas in the Lyceum Theatre at Edinburgh, where the "Lady of the Lake" is being produced.

Mr. W. T. Makins, writing to the *Times* upon the Grand Theatre fire, says: "The main obstacle to the adoption of electric lighting for stage purposes is not, as is generally supposed, its costliness; but is, I believe, its unsuitability for the purpose, on account of the difficulty, if not the impossibility, of partially raising and lowering the light as required for scenic effects—a drawback which is not shared by gas." Mr. Makins is altogether misinformed in this matter, as electric lights can be raised and lowered at will.

The *Times* says, respecting the fire at the Grand Theatre: "The outbreak occurred in the 'flies,' as was believed to have been the case in the Exeter disaster, and it has been suggested that an escape of gas, fired by one of the jets left burning throughout the night for purposes of inspection, may have been the proximate cause of the accident. Gas, it will be remembered, was also supposed to have occasioned the Exeter calamity. At all events, it is notoriously responsible for most theatrical fires; and if it really caused the destruction of the Islington theatre, which was chiefly illuminated by the electric light, the fact may serve to teach the proprietors and lessees of such buildings that it is useless to employ the safer method of illumination in one part of the house while the old and dangerous system is used in another."

Electric Lighting in Milan.—There are 100 Schwerd arc lamps and over 300 Bernstein glow lamps, the latter varying from 25 C.P. to 50 C.P., in use at the Terni Steel Works, Milan. The area occupied by the works is 210,500 square yards.

The Lever System.—This method of electric lighting is being installed at the works of Messrs. Smith and Coventry, Salford.

Private House Lighting.—Weston Hall, near Otley, the private residence of Mr. W. C. Dawson, is very effectively illuminated by the electric light. A 6 H.P. (nominal) Robey engine drives a Crompton shunt dynamo supplying current for 120 Edison-Swan lamps of 8 and 16 candle-power. The installation also includes 35 E.P.S. accumulators. Not only are the principal rooms of the house lighted by electricity, but the kitchen, pantries, laundry and stables also have suspended and bracket lamps. Messrs. H. Walsh and Son, of Leeds, successfully carried out the work some months ago.

Electric Lighting in Imperial Castles.—The Emperor of Austria has ordered an extension of the glow lamp installation in the Imperial Castle at Laniz, and every room is now to be lighted by electricity, for which 1,000 lamps will be required.

Electric Light Helping a Brave Man.—Edward Devereux, when rescuing a boy who had fallen overboard from the *Exmouth* training ship at night, received substantial assistance from the electric light, which enabled him to discern his object at a distance of five hundred yards from the ship.

Lighting of the Bute Docks.—Arrangements are rapidly being pushed forward for the lighting of the Bute Docks, Cardiff, by electricity instead of, as at present, with gas. The Brush system will be adopted, and twenty lamps will be hung.

Central Station at Lubeck.—Messrs. S. Schuckert and Co., of Nuremberg, have erected a central station for the municipal authorities of Lubeck, in Germany, and the lighting commenced on November 22nd. A steam engine with valve gear and four Schuckert dynamos constitute the plant; two additional dynamos are to be put in. There are 1,000 glow lamps of 16 C.P. and 20 arc lamps of 600 C.P.

The firm of G. Binswanger & Co., 5, Great St. Thomas Apostle, is in a position to supply particulars of all the manufactures of Schuckert & Co.

Bradford Electric Lighting.—We understand that a meeting has been arranged between the chairman of the Gas Committee and Dr. Hopkinson with regard to the electric lighting scheme for Bradford. Dr. Hopkinson will go to Bradford and examine the plans and specifications as well as the proposed site for the central station and the various routes for the mains. He will then give his opinion to the committee as to the feasibility or otherwise of the scheme which has been the subject of so much correspondence in the columns of the local newspapers.

Vienna Town Hall.—The installation in the Town Hall at Vienna has proved more costly than was at first anticipated, but the municipal authorities have nevertheless decided to extend it.

Melbourne and the Electric Light.—At a recent meeting of the Melbourne Town Council, the Mayor drew attention to the Electric Light Company's Bill before Parliament, and asked for the opinion of the council on the matter. He thought the bill would interfere with the operations of the council in lighting the town if it were allowed to pass. He was of opinion that both the supply of water and light to the town should be in the hands of the corporation only. Alderman Button pointed out that the project had been before the council some four years. The light had been tested, but at that time the system was in its infancy, and it had been decided to defer its application to the town. The time had now arrived when improved appliances had rendered it feasible, and the council might fairly adopt it. He moved—"That this council, having applied to Parliament for power to undertake works for lighting the town by electricity, is of opinion that to confer like powers to do the same work, on a private company would be in the highest degree detrimental to the public welfare, and resolves to petition Parliament to withhold its assent from such last mentioned bill." Alderman Barrett thought the council was making more of the matter than it deserved. The bill was a transcript of a bill for supplying Grafton, in New South Wales, with electric light, and the powers asked for were no more than those granted by the N.S.W. Legislature. He was sorry to see that, when people proposed to spend £50,000 here, they were met in such a narrow spirit. Alderman Sadler thought the bill gave the company too much power, but no more than that given the Gas Company. Still, he hoped, if the corporation would guarantee to light the town with electricity within a given time, that the Corporation Bill would pass. The motion was carried. It was considered advisable that a date should be fixed for the commencement of operations, and it was decided to recommend two years as the limit.

Electric Lighting in Egypt.—Mr. F. d'A. Goold, who will be recollected in connection with central station experiments in Manchester, is now at work in Egypt with the problem of domestic electric lighting by the aid of water power. He has entered into a contract with the Alexandria Water Company under which he holds the sole right to instal water motors for electric lighting purposes for a term of 10 years. Mr. Goold carried out a successful installation at a recent *fête champêtre* given by H. E. Ghazi Mukhtar Pasha. His Highness the Khedive was charmed with the light, and was "graciously pleased to honour Mr. Goold with a special mark of recognition."

Electric Light in the Royal Navy.—The Admiralty having abandoned the idea of building a naval college on shore, it is intended to light H.M.S. *Britannia* by means of electricity, the estimated cost of bringing about this improvement being £3,000, an expenditure which is to be incurred on the supposition that the ship is good for another 20 years. A contract has been entered into with Mr. Scott to fit up 450 incandescent lamps for £650, the apparatus and machinery being furnished by the Admiralty. The work is to be completed by the middle of January.

Gas Ousting Electric Lights.—Writing to the *Gas World* on the subject of gas and electric light, Messrs. Baxendale & Co., Manchester, say that some time ago Messrs. Hope Brothers, of Ludgate Hill, London, opened an extensive branch establishment in the leading thoroughfare of Manchester. The nature of their business requiring a powerful outside light, they determined to fit up electric arc lamps the whole length of the building. This was done by one of the leading electrical engineers in Manchester, but the uncertainty of the light and the loss of a man's time, who was kept constantly attending to the lamps, caused the firm to look out for a substitute which would require no attention, and which would yet give a powerful light. It was determined to place over the entrance two of the "Bower" regenerative gas lamps, fitted with Baxendale's storm proof covering. These were fixed, and they have given such satisfaction that eleven others have been put up, and the electric lamps taken down. Such is the story of Messrs. Baxendale & Co. What we have to say is, that Messrs. Hope Brothers did not exercise reasonable care in lighting their shop front by arc lamps which were uncertain in their action. There are lamps of a perfectly trustworthy type suitable for the purpose; if Messrs. Hope Brothers had used Pilsen or Brockie-Pell lamps, for instance, the lighting would have been satisfactory—providing, of course, the installation work was properly performed.

Electric Lighting in Kansas.—It is said that every town in Kansas that has a population of 3,000 and upwards is lighted by the electric light.

Telephonic Extension in the Dundee District.—The trunk wire joining the National Telephone Company's Dundee and Kirkcaldy exchange systems was completed last week. The length of the wire, including the cable under the Tay, is fully 30 miles. Kirkcaldy is already connected with Stirling, Alloa, Dunfermline, and other towns in that district, in addition to being in communication (through Stirling) with Glasgow and Edinburgh. Communication with Glasgow and Edinburgh will not yet be opened, but the company is at present endeavouring to obtain sufficient encouragement to warrant its proceeding with direct wires to connect Dundee and district with these important cities and the adjacent towns.

Springs on Telegraph Wires.—We read in *La Lumière Electrique* that some years ago Mons. Bardonnaut, of Toulon, proposed the employment of spiral springs on telegraph wires in order to obviate the singing which forms so disagreeable a feature in a high wind. The system referred to consists in the placing on either side of the insulator of a spiral spring, the line wires being attached to the extremities of these spirals; the continuity of the circuit is effected by a loop wire soldered on to the line wires beyond their junction with the spiral springs. Our contemporary remarks that no doubt Mr. Caws, of Sunderland, who has lately taken out a patent on very much the same lines, is in ignorance of the prior claims of Mons. Bardonnaut, who filed his patent in 1883.

The Telegraph on the Field of Battle.—The importance which is attached by the French and German military authorities to the subject of telegraphy for field purposes has induced the War Office to pay some attention to the same subject. Captain Cardew has lately laid before the authorities an instrument which combines both a telephone and a sounder, and is said to be so simple in construction and so sensitive to the electric current that it will work in all weathers through common bare wire lying on the ground. By this means, it is claimed, a field telegraph could be erected as fast as an army moved, thus rendering outpost and reconnaissance duty much easier. It is even hoped that the instrument would be of considerable use on the field of battle.

German Cables.—The Reichstag will shortly consider the proposed purchase by the German Government of the cables between Germany and England. About 8½ million francs will be required for this purpose. Should the scheme be carried through, a very large reduction in the existing tariffs will be made.

A Professorial Jubilee.—The well-known electrician, Professor Weber, of Göttingen, celebrated his Jubilee as Honorary Doctor of Medicine of the University of Königsberg on December 28th, when the University presented him with a new and splendidly illuminated copy of his diploma. The Vice-Rector, in his speech of congratulation, spoke of Professor Weber as not merely a great scientist, a deep thinker, and a sagacious and daring experimenter, but also as "one who at a critical time did not hesitate to stand up for truth and right at the risk of sacrificing everything." This was a graceful reference to the fact that the old Professor was one of the famous "Göttingen Seven," who in 1837 were expelled from the University for their protest against the violation of the Constitution by King Ernest of Hanover.

Damaging a Dynamo.—Samuel Rowbottom, an electrician, was recently fined 10s. and costs and 1s. damage, at the Derby police-court for cutting the wire connecting the dynamo with the lamps in the shop of Mr. D. W. Bardill, chemist. The defendant alleged that the wire was his own property. His firm had supplied the materials for the installation, and had charge of it for some time. When Mr. Bardill wished them to surrender it into his hands, defendant simply did what he had a right to do, that is, took his own property. The magistrates took a different view, as evidenced by their verdict.

Personal.—Professor Samuel Pierpont Langley, LL.D., has been elected secretary of the Smithsonian Institution at Washington, to succeed the late Professor Spencer F. Baird. Professor Langley was previously assistant-secretary of the Institution.

Electricity in Mines.—Mr. A. L. Steavenson declines to take it for granted that electrical transmission of power is more efficient commercially than any other form of power transmission. In a correspondence proceeding in *Engineering* he quotes various authorities and adduces his own experience to the effect that from 33 to 60 per cent. efficiency may be attained with compressed air, whereas 35 and 40 per cent. are the highest efficiencies claimed for electricity—as far as this correspondence is concerned. In referring to the remark of Prof. Osborne Reynolds in a discussion on the transmission of energy at the Society of Arts that "so far as efficiency of transmission in considerable quantities is concerned, neither secondary batteries nor electrical transmission are more efficient than compressed air, or belts, but when it comes to transmitting small quantities then electric transmission has a decided advantage," Mr. Steavenson says that in mines they generally want large quantities of power transmitted.

Rain to Order.—An American doctor (the phrase is somewhat suggestive) claims to be in possession of "a patent to open the windows of heaven at the will of man." "What I have invented," says Dr. Cahill, "is a condenser of peculiar shape and construction, and connected with the earth by an electric cable." When the watery vesicles floating in the air come in contact with the condenser or current, the doctor assures us that they will be broken up and forced to the ground with great rapidity, the rain being produced by the same law that causes condensation on a window pane. A condenser of about 200 feet in diameter is warranted to bring down something like 25,000,000 gallons a day, and "the volume of water can be preserved or formed into rivers, whichever may be desired." The operation will, in short, be somewhat akin to pulling the string of a tremendous shower-bath. Invent the opposite, doctor, and come to England!

Journalistic Change.—With the new year our excellent and highly esteemed New York contemporary, hitherto known as *The Electrician and Electrical Engineer*, will appear as *The Electrical Engineer* only. With a less burdensome title to carry we feel sure our old friend will display no falling off in the admirable quality of the electrical literature which it puts before its readers every month.

The Comp.'s Latest Rival.—A. S. Capehart, proof reader on the Minneapolis *Tribune*, and S. G. Goodson have devised a machine which it is said will revolutionise the whole business of printing. The two conceived the idea that electricity might be employed to do the work, and finally submitted their plans to C. L. Redfield, a well-known mechanical engineer, editor of *Wood and Iron*. He made some valuable suggestions in the line of rendering the idea practicable, and made the drawings. The models worked well, and recently a machine was completed. It turned out 5,000 "ems" an hour, against the 1,100 ems the average compositor can now set. The success of the machine was such that a number of local capitalists were at once interested in it, and the Minneapolis Electro-Matrix Company has been incorporated, with $1,000,000 capital. The machine is not properly a type-setting machine, for it uses no type at all, but a matrix-making machine. The letters are punched in a strip of cardboard, of the width of a column, from which a stereotype is made in exactly the same manner as stereotypes are now made from pasteboard matrixes. The work of punching the dies in, of feeding in the cardboard, and of preparing it for the next stroke, is all done by electricity. One man operating the electro-matrix machine will, it is asserted, supplant at least five men setting type.

Adelaide Jubilee Exhibition.—Messrs. R. E. Crompton & Co. have been awarded First Order of Merit for their dynamo machines exhibited at the Adelaide Jubilee Exhibition.

An Award Scheme.—The fourth annual report of the award committee of Messrs. Denny & Co.'s engine works at Dumbarton has just been issued. Under the scheme awards are given to workmen who may invent any new tool or improve or modify any existing tool. The committee say that they have made a careful analysis of all the claims sent in from the beginning, and now give the results in the following table:—Additions to or modifications of present machinery, 24 claims; new hand tools, 15 claims; other appliances for improving or cheapening work, 11 claims; using present machinery for new purposes, 4 claims; new tools of larger class, 3 claims; electric motor, 1 claim—total claims, 58. The number of successful claims out of the whole is 21, or fully 36 per cent., and the total sum awarded is £84.

Gas Explosions.—Last Friday afternoon a serious explosion of gas occurred at 22, Lawrence Road, Bow. Much damage was done to the property, and Mr. J. M. Lindsey was badly burned about the hands and face; Mrs. Lindsey was burned on the hands and arms; and their little boy was severely burned on the arms and head.

In the evening of the same day an explosion of gas took place in the basement of the premises occupied by Carlo Gionora as supper rooms immediately opposite the Surrey Theatre. Police-constable W. Webber was much injured about the face.

A Notorious Promoter.—Do any of our readers recollect Dr. S. W. Emmens? Rather, perhaps, should we ask, has anyone forgotten that personage? *Money* is now "strenuously and emphatically" warning American contemporaries against Dr. Emmens, who seems to be occupied in exploiting in the States "a new and wonderfully powerful, and, at the same time, exceedingly docile explosive," which is to be known as "Emmensite."

An Electric Lock.—A new electric permutation safe-lock has been brought out in Chicago, which differs materially from all other safe-locks in the fact that there is no orifice to speak of in the door of the safe. The dial rests in a magnetic block, from which wires extend and communicate with magnets which set up the tumblers in the lock, and so permit of the throwing back of the bolt bar. This releases a spring or body of compressed air, as the case may be, which in turn releases the heavy bolt work. The wires penetrate the top plate of the safe at the jamb of the door, and move in a zigzag course through the inner plates to the lock. The wires are so small and their course so crooked, that it is claimed that they cannot be traced by explosives. A current of electricity is obtained from several small batteries by pressing down a key on the vulcanite block that holds the dial.

Cheap Gas.—Gas at three-halfpence per thousand cubic feet! Such, says the *Gas World*, is the statement which, we believe, Mr. Geo. E. Davis made to the members of a dinner party in Salford the other day. As Mr. Davis has not contradicted the statement, we must take it that he really meant what he is made to say in public print. In the absence of details regarding the accomplishment of this physical and commercial feat, we must be pardoned if we accept the statement with a mental reservation. We do not know what sort of gas Mr. Davis referred to, but, if it is light-giving gas, he might have mentioned the name of the material from which it is obtained. It cannot be from coal, nor do we see what other substance is available for such a cheap supply.

Helping Lightning Down.—"Oh, yes," said a grumbling beggar, "folk al'ays helps them as don't need any help. Why, there's lightnin'; it can git down to the ground fast enough all by itself, and yit folks is all the time a-putting up rods for it to slide down on."

The "Brush" Calendar.—The Anglo-American Brush Electric Light Corporation has sent us a very chastely designed and prettily arranged calendar. In addition to containing useful electric lighting data, the centre of the card contains a photograph (7½ inches by 6 inches) of a Victoria dynamo and Brush engine connected by friction gear, representing a complete plant capable of maintaining 100 incandescent lamps of 17 candle-power.

Modification of Title.—The company hitherto known under the name of the General Electric Apparatus Company will in future bear a shorter title, the word "Apparatus" being eliminated.

A Word to the Wise, &c.—It is almost certain that the theatrical managers who have sufficient acumen to at once depend upon electric lighting in their buildings, will secure the patronage of the majority of pleasure seekers, and that those who still stake their popularity upon their own reputation as caterers and the aid of gas, will find their receipts materially reduced.

Accidents in Theatres.—A curious accident has happened at the Beaumarchais Theatre, Paris, which has been completely flooded by the bursting of one of the pipes leading from the reservoir containing the water kept ready in case of fire. Another, not unlike this in character, took place in the Theatre Royal, Edinburgh, on Wednesday. A man at the back of the gallery climbed upon a water pipe in connection with the fire arrangements, and it broke beneath his weight. The hissing of a large jet of water caused a panic, and the cry of "fire" arose. A mad rush to the exit ensued; but as these were ample no fatal accidents are chronicled, although many persons are reported as being crushed.

Assaulting an Electrician.—John Lee was charged on Wednesday with assaulting Mark Wilton, an electrician, and John Turner, an engine driver, in the engine-room of Winchester House, Old Broad Street. The defendant acknowledged having committed the assaults, but argued that he had been provoked by one of the defendants having whitewashed the engine-room without removing his clothes, which were spoilt. The Alderman fined him 40s. for the first assault, and for the second bound him over in his own recognizances of £5 to keep the peace for six months.

The Rise in Copper.—Owing to the extraordinary rise in the price of copper, it has been determined to re-open the copper mines at Coniston, which have been closed for over five years. These mines have been purchased by Mr. Thomas Wynne, and in all probability about 50 men will be employed. The P.O. authorities have been compelled to entirely abandon the erection of copper lines and to revert to iron.

A New Torpedo.—Colonel Lay has recently invented a torpedo which is said to be of a very deadly description. It consists of a brass tube 21 feet long and 18 inches in diameter, the charge being composed of roburite, the new explosive. It can be launched either from a ship or from the shore, and explodes by impact or by electricity.

The Direct U.S. Calendar.—We have received a copy of the Calendar for 1888 issued by the Direct United States Cable Company, Limited, which contains many important and interesting items in connection with submarine telegraphy, and also a record of various electrical discoveries since a very early period. The calendar, which is simple yet appropriate in design, is likely to be very useful for reference purposes.

A Foot-rule Calendar.—Mr. A. S. Tucker, of 143A, Euston Road, has sent us copies of a novelty he is distributing, which will be found useful by all who have occasion to use a measure. It consists of a combination of a four-fold foot rule with scales $\frac{1}{4}$, $\frac{3}{4}$, 1 and $1\frac{1}{2}$ inches to the foot, and a calendar for 1888. It is printed in gold, black, and red upon linen card, so as to stand considerable wear. Mr. Tucker offers to send one to any applicant who encloses two stamps, the proceeds being devoted to some charitable object.

Chicago Electric Railway.—The overhead railway shortly to be commenced in Chicago will be worked by electric traction. The total length of line will be about 35 kilometres, with stations at intervals of 900 metres. The rails will be at a height of 5·40 metres above the level of the streets.

Cable Trams in Birmingham.—Birmingham has now a cable line in addition to steam and horse propelled tramcars. The threading of the steel wire was completed early on Sunday morning. We are surprised to read that, although this, the first instalment of the cable system in Birmingham, is said to be far superior to any line previously put down, it is feared that the central slot through which the grip works will for some distance soon become contracted, consequent upon the swelling of the wood paving, laid down despite the energetic protests of the engineers. At one point it has already narrowed to the extent of half an inch, and interferes with the working of the line, and maybe the promoters will yet fall back upon electricity. Mr. Pritchard, of Birmingham, and Mr. Joseph Kincaid, of Westminster, are the engineers of the line.

Versatile, very!—A correspondent writes:—"What is 'our profession' coming to? In this week's list of Bills of Sale, under Middlesex, I was amused to see that one man styled himself 'comedian and electrical engineer,' and another man 'general agent and electrician.'"

Edinburgh and its Gas Question.—The Edinburgh Town Council decided last week to decline a petition from the ratepayers for a plebiscite upon the question of the purchase of the gasworks, and also rejected a motion to inquire into the condition, financially and otherwise, of the Edinburgh and Leith Gas Light Company's undertaking before completing any agreement for its purchase.

Medicine and Electricity.—Another application of electricity! The potent force is now used to introduce medicine into the human system. The electrodes of a battery or coil are saturated with the medicine and applied locally to the skin, and the experiments made are said to show that there is an actual absorption of the medicine into the system.

Still Another Fatal Accident.—James O'Connell was killed on the stage of the Harris Museum at Cincinnati on December 10th. An arc light wire was in contact with a speaking tube against which a bell wire also rested. O'Connell received the current when attempting to ring down the curtain.

An Indiscreet Young Man.—Thomas Withall, said to be a telegraph engineer, charged with being concerned in defrauding Mr. Joseph Wolff of 35 shillings by means of the three-card trick in a railway carriage, was on Saturday discharged with a caution to be more careful as to his company in future.

Long-Deferred Honour.—The Queen has been pleased to approve the appointment of Mr. John Pender to be Knight Commander in the Order of St. Michael and St. George. Mr. John Pender is a son of the late Mr. James Pender, of Dumbartonshire, and was born in 1816. He was educated at the High School, Glasgow, and, devoting himself to commerce, became a merchant in Glasgow, Manchester and London. He has long been identified with the promotion of submarine telegraph cables, and is chairman of the Eastern, Eastern Extension, Direct United States and other telegraph companies. Mr. Pender occupied a seat in the House of Commons for several years, representing Totnes and the Wick boroughs. He has been twice married. Colonel Robert Murdoch Smith, another of the new knights, is the superintendent of the Indian and Persian telegraphs, stationed at Teheran. His first commission, as lieutenant in the Royal Engineers, was dated September 24th, 1855; he became major in 1873, and lieutenant-colonel in 1881.

The Carbon Trade.—We are requested to state that the Globe Electrical and Engineering Company, of 7, Carteret Street, Westminster, is the sole London agent for the Barnsley Carbon Company, of Barnsley, and will supply both carbon rods and plates from its London stores at the same price and terms as the Barnsley Carbon Company.

The Electric Light "Rattened."—Amongst the leading tradesmen of Sheffield who have adopted the electric light is Mr. Atkinson, draper, &c., of South Street, Moor. He has had 10 arc lights fixed on his premises by the Sheffield Electric Light and Power Company. The lights are supplied by a wire leading from the central station in Commercial Street, and were lighted for the first time on the Friday evening preceding Christmas Day. All went well until after the engines were stopped on Wednesday week at half-past 11. The main circuit wire, which consists of seven strands of No. 18 copper wire, insulated with gutta-percha and covered with prepared woven cotton, was found on the Thursday morning to have been cut quite through, leaving the two ends hanging down. The act appears to have been premeditated and planned, as the wire could not be reached without a ladder or something of the kind.

New Year Paper Knife.—We have received the annual gift of a paper knife from the Eastern Telegraph Company. Not only is it adorned with the usual map on the blade, but the handle is now utilised for a miniature calendar of the year 1888.

NEW COMPANY REGISTERED.

Shippey Bros., Limited.—Capital, £30,000 in £5 shares. Objects: To take over the business of Mr. Arthur Shippey, of 13 and 14, King Street, Cheapside, trading as Shippey Bros., electrical engineers and lighting contractors; and to establish works in England and abroad for the manufacture of electrical apparatus, dynamos, lamps, and other appliances. Signatories (with one share each), J. J. Michael, 23, St. Quintin Avenue, North Kensington; R. W. Bilby, 30, Bartholemew Road, N.W.; A. Beckwith, 10, Noble Street, E.C.; E. H. Vagg, 3 and 4, Crown Court, Threadneedle Street; W. H. Le Fevre, C.E., 26, Budge Row; L. N. Loeb, Church Alley, Basinghall Street; B. Newstead, 77, Gresham Street. The signatories are to appoint the first directors; qualification, £200 in shares, stock, or debentures; the company in general meeting will appoint remuneration. Registered 30th ult. by J. A. Bartrum, 11, Old Jewry Chambers.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

South Staffordshire Electric Lighting Company, Limited.—The annual return of this company, made up to the 29th ult., was filed on the 2nd inst. The nominal capital is £100,000 in £5 shares. 139 shares have been taken up and the full amount has been called thereon, the calls paid amounting to £690 and unpaid to £5.

John Fowler & Co. (Leeds) Limited (Hydraulic and Telegraph Engineers).—The annual return of this company, made up to the 23rd ult., was filed on the 31st ult. The nominal capital is £680,000 divided into 50,000 preference and 18,000 ordinary shares of £10 each. 28,443 preference shares have been taken up and the full amount has been paid thereon. 18,000 ordinary shares have been allotted and are considered fully paid up. Registered office, 6, Lombard Street, E.C.

Buenos Ayres Electric Light Company, Limited.—The annual return of this company, made up to the 29th ult., was filed on the 30th ult. The nominal capital is £100,000 divided into 9,986 shares of £10 each and 70 founders' shares. Although the company was registered in November, 1881, the only shares taken up are the 70 founders' shares, and upon these no call has been made. Registered office, 1, East India Avenue.

Medico-Electric Belt, Truss, and Battery Company, Limited.—An agreement of 29th ult. provides for the allotment to Wm. George Johnson, of 64, Cambridge Terrace, Hyde Park, of 100 fully-paid shares, in part satisfaction of the moneys payable to him under an agreement of the 9th inst.

Under another agreement of 29th ult. this company will allot and issue to such of the holders of shares in the Medical Electric Belt, Truss, and Health Appliance Company, Limited, as shall be entitled thereto under the provisions of an agreement of 26th November, a fully paid up share in this company for every fully-paid share held in the old company.

Cowles Syndicate, Limited.—An agreement of 21st ult., filed 29th ult., states that this company purchases from the Cowles Electric Smelting and Aluminium Company, of Cleveland, Ohio, U.S.A., certain letters patent and other rights for £106,000, payable £6,000 in fully-paid preference shares, and 10,000 fully-paid ordinary shares. The vendors have agreed forthwith on subscriptions being received for 3,000 preference shares to request the purchasers to allot to each subscriber out of said 600 preference shares so many shares as shall be equivalent to 20 per cent. of the amount of his subscription, and without requiring any payment therefor. Subscriptions for the whole of the 3,000 preference shares have been received, and accordingly the 600 vendor's preference shares are allotted amongst the subscribers.

CITY NOTES, REPORTS, MEETINGS, &c.

International Cable Company, Limited.

THE first annual general meeting of this company was held at the offices, 34, Nicholas Lane, E.C., on Thursday, the 29th ult., under the presidency of Mr. W. J. Thompson.

The Secretary having read the notice convening the meeting,

The Chairman said: I appear before you as the chairman of a company which had a very warm reception at its start. We were quite prepared for opposition, as the many supporters of the existing companies were sure not to be friendly to our scheme, and certain parties thought themselves justified in casting ridicule upon it in the Press; but having been engaged in this project now myself some considerable time, I must acknowledge the courtesy which I have experienced from all concerned in it, and though some people have made strong remarks they never cast any reflection on the directorate, and I may even go further and say that had they looked through other-coloured glasses their verdict would have been with us. There is only one matter that I would further mention on this subject, and that is that some reference should be made to a remarkable letter which I think damaged this company most seriously, and even at this time I cannot realise what the writer intended, or whether he really weighed in his mind what would be the effect of his words. The letter damaged this scheme; but you will hardly credit it that the writer was at that time a director, if not the chairman, of a syndicate anxious to promote this scheme. We shall now ask your opinion as to what you wish us to do in this matter in future. We hold the opinion that the proprietor of a single share in the company is as much entitled to his opinion as the holder of 100 shares. Had we studied our own ease and comfort we should have retired as soon as we found the public held back. We had large promises from Liverpool and Glasgow which failed; but as there were large subscriptions from parties professedly anxious to see the scheme carried through, the directors feel they should not resign as long as there is any appearance of success. They determined, however, that unless they could be satisfied that there were sufficient funds to carry out the scheme in its entirety, they would not risk the money of the subscribers, although there were frequent requests to commence. Certain foreign subscriptions proving doubtful was another reason for over caution. Your directors have worked at their own personal cost, and hoped to the last, and our hope has not been abandoned. The promoters, on their part, met the different position most frankly, and consented to forego half their claims. A member of the board offered at his own cost to put himself in communication with his friends in Paris. He went over bringing the scheme to the notice of his friends. When there he made an arrangement with Count Dillon, and after this he went over at the request of the board to Portugal and saw his Excellency Senor Aguilar, late Minister of Public Works, and obtained an important extension of the contract for the concession from 20 to 40 years. There were minor concessions, and I may say you cannot too much thank him, though he requests that his name may not be mentioned. It will also be in the recollection of some of you that the British Government invited tenders for a cable from Halifax to the Bermudas. As this was part of our scheme and would have been a key to our cables, to which we felt we might look, we entered into negotiations on the subject, and we have every reason to believe that if the British Government had not subsequently determined to defer the tender it would have been given to this company. Had it been so we should have been in a position to lay down our cable. However, the thing is not entirely dropped. An official from the General Post Office called last week on Mr. Sydney Thompson to know if the scheme was going on. If we had succeeded in this, we could have gone on and found funds sufficient for carrying out the entire scheme. Well, we have also had communications from America and Spain to work with the company, but until the main question is settled we feel it would be needlessly taking up time to consider these questions. At the present moment, the increased cost of copper is unfavourable; but, on the other hand, there seems to be less desire on the part of the existing companies to continue the war of rates. Well, you must decide as shareholders what to do. Our position as directors has been anomalous. We always desired to go on if we could, and fairly and honourably. If the shareholders wish us to continue in office, I think we shall be willing to remain for six months. If, on the other hand, you come to the conclusion to close operations, we shall be prepared to resign and give the seven days' legal notice for a meeting. We have the money subscribed lying at the bank at seven days' call, where it has been since we received it—excepting something less than £600 which have been

required for expenses of office, secretary, &c. The board made no charge, and as we have nothing more to add, I shall now be happy to hear your views.

Mr. Surén said it would be important to know how much money had been subscribed and how much paid in.

Mr. Fox replied that 21,000 shares had been applied for, and £8,344 paid on application and £811 on allotment.

Mr. Surén asked how much per cent. the expenses would be on the capital paid in.

Mr. Fox: About 10 per cent.

Mr. Surén: Well, I think the sooner we wind up the better, and I move that the company be wound up.

Mr. Dain: I second that. I never had a notice of the first meeting.

Mr. Sydney Thompson (the solicitor) said the first directors were the shareholders, and they appointed the present directors.

Mr. Dain: Perhaps you will tell us if there has been any other meeting of the shareholders?

Mr. Thompson: No, there has not.

The Chairman: There has been no change on the board, except that Lord Brabourne has retired and Senor Aguilar has died.

Mr. Holroyd said he had a considerable sum at stake in this company, and proposed that it should not be wound up. From his information about it he did not think that would be a proper course, and he did not see why it should not be carried on to a successful issue.

Captain Wood seconded the amendment that the company be not wound up, adding that he did so on the understanding that the present board should remain in office. He was sure the shareholders would loyally support them in every way. The remarks of the chairman in regard to the concession from the British Government were very appropriate, though probably it would not be wise to disclose all that took place. In the case of the company going into liquidation there would inevitably be heavy expenses both in litigation and liquidation, and probably, instead of getting 90 per cent., they would only get 10 per cent. returned. In regard to the concession, if they put on a bold front to the Government, he believed they would get it.

Mr. Gribbon spoke in support of the amendment. He was strongly interested in the company, and thought if the present board remained in office another six months, there was every prospect of bringing it to a successful issue. With a little more patience, the company might be made a success.

Mr. Pope said if any information could be given to the meeting which would lead to unanimity it would be an advantage. It seemed to him an absurdity, seeing that they had a concession from the Portuguese Government for 40 years, that they should wish to wind up. He supported the amendment.

Mr. Surén said his idea was to save all they could, and he didn't see that there need be any litigation.

The Chairman: We take it as your decided opinion that the company should be wound up.

Mr. De Ricci: Gentlemen, by your kind permission I wish to testify to the wonderful way in which our chairman has worked, and, in answer to the very proper question put by Mr. Surén as to the amount that would be returned to you, desire to say that the sum mentioned by the chairman does not anything like represent what has been actually spent in the matter. I myself have spent more than half of that. I should be glad to be relieved of the responsibility of bringing this matter to a satisfactory issue. Whilst some have their thousands in it I have only £500. We have already achieved considerable results, and if you think it advisable we will still persevere, and perhaps it might be desirable to adjourn for a shorter period.

The Chairman: Before I ask you to vote, there has been one point referred to as to the possibility of litigation. That is a point I have not taken into consideration. When certain gentlemen subscribed for the concessions, we had guarantees that they would not call for the return of that money. How the law would affect us I don't know. I cannot add more. I will now put the amendment that the International Cable Company shall not be wound up.

Nine voted for the amendment and five against.

The Chairman: Very well, gentlemen, then the amendment is carried, that the company shall not be wound up.

Votes of thanks to the chairman and directors were passed, and the meeting separated.

National Company for the Distribution of Electricity by Secondary Generators, Limited.—At the fourth ordinary general meeting of this company, held last week at the offices, Warwick Street, Regent Street, under the presidency of Mr. Wm. D'Oyly, the directors' report was received and adopted. Acting on the advice of eminent counsel and scientific authorities the directors have instituted proceedings against infringers in the English and foreign courts. The installation at Tours, in France, which had been working satisfactorily without interruption since January, 1886, was the object of attack by infringers, whose patent was ultimately declared invalid, the Court of Tours giving damages to the Banque d'Escompte de Paris, which held an exclusive licence to employ this company's system in France. The directors had claimed damages against the Banque d'Escompte, whose contract with the company they had now cancelled. An action against Sir Coutts Lindsay & Co., Limited, had been settled by the payment by the defendants of the royalties claimed and costs. In 1886 Mr. Ferranti filed a petition for the revocation of the Gaulard-Gibbs patent, alleging informalities and anticipation, and subsequently the National Company brought another action for infringement against Sir Coutts Lindsay & Co. and Mr. Ferranti; these actions had yet to be tried. The company had attacked two infringing patents with success in Germany, where the co-operation of Messrs. Siemens & Halske had been secured. Mr. George Westinghouse had upheld their patents in the United States Courts. That gentleman in a recent letter said he was quite confident that by January 1st, 1888, they would have more than 120,000 lamps in use with secondary generators. The 80 central stations in the States had produced upwards of £4,000 in royalties to the company. Messrs. Hammond & Co. were employing the Gaulard-Gibbs system at Eastbourne and Brighton, and negotiations were in progress for the extensive use of the system in other parts of the country. The directors had closed the Castle Street works, and entered into a manufacturing contract with Messrs. Elwell-Parker, of Wolverhampton. A contract had been entered into for transporting 2,000 horse-power from the Tivoli Falls to Rome. Tivoli had been lighted by the company's system since August last year. The directors anticipated a great future for the company by judiciously meeting the desire generally manifested to recognise the company's foundation patents. To secure this end they proposed to ask moderate royalties, and to supply the most efficient apparatus at prices that would remove even the temptation to infringe. Mr. Lucien Gaulard and Mr. J. Dixon Gibbs, directors, and Mr. J. H. Thornton, auditor, were re-elected.

German Union Telegraph Company, Limited.—This company announces the payment of an interim dividend of 11s. 9d. per share, payable on the 7th inst.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of December was 3,925, estimated to produce £3,300, against 5,695 messages, producing £3,125 in the corresponding month of last year. The receipts for the month of September, estimated at £2,500, realised £2,494.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st December are £2,896, as compared with £3,089 in the corresponding period of 1886. The September receipts, estimated at £4,357, realised £4,455.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 30th were £3,318, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Great Northern Telegraph Company, Limited. The receipts for December, 1887, £21,600; from January 1st to December 31st, 1887, £264,480; corresponding months, 1886, £258,000; and of 1885, £284,720.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of December were £2,004, against £1,782 in the corresponding period of last year.

The Eastern Extension, Australasia and China Telegraph Company, Limited. The receipts for December amounted to £38,908, and to £40,539 for the corresponding month of 1886.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending December 31st are £4,300.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended December 30th amounted to £4,102.

The Eastern Telegraph Company, Limited. The receipts for December amounted to £57,705, and to £52,823 in the corresponding month of 1886.

NEW PATENTS—1887.

17548. "Magneto-electric machines for firing explosive charges for mining, &c." M. SETTLE. Dated December 21.

17582. "Indicating the time during which electricity is used for lighting, &c." E. F. H. H. LAUCKERT. Dated December 21.

17585. "Electric regulators." N. BERNARDOS. Dated December 21.

17592. "Laying electric wires." R. B. LEE. Dated December 22.

17599. "Dynamo-electric machine." R. E. B. CROMPTON, J. SWINBURNE. Dated December 22.

17631. "Electric batteries." J. C. LEMMENS. Dated December 22.

17641. "Printing telegraphs." J. E. WRIGHT, J. MOORE. Dated December 22.

17655. "Electric incandescent lamps." R. H. D. MILLS. Dated December 23.

17669. "Telephonic apparatus." D. J. SMITH, D. SINCLAIR. Dated December 23.

17682. "Switching apparatus and vibrating appliances for mechanical telephones." T. CHEESMAN. Dated December 23.

17704. "Telephones." A. C. HERTS. Dated December 23.

17722. "Electric telegraphic apparatus for transmitting and receiving signals on board ship." J. S. GISBORNE. Dated December 24.

17726. "Electro-motors." J. G. STATTER. Dated December 24.

17757. "Applying portable electric batteries and incandescent lighting to articles of wearing apparel, &c." M. MCMULLIN. Dated December 24.

17762. "Electric signalling apparatus." L. SELLNER. Dated December 24.

17768. "Covering or insulating wire." W. S. SMITH. Dated December 24.

17807. "Rheostats or similar electrical instruments." F. L. RAWSON. (Communicated by C. Wirt.) Dated December 27.

17812. "Machines for the production of alternating electrical currents." C. ZIPERNOWSKY. Dated December 27.

17837. "Generating electricity from heat." P. M. JUSTICE. (Communicated by E. G. Acheson.) Dated December 28. (*Complete.*)

17840. "Self-replacing electric indicator." C. D. BARKER, F. C. HILLS. Dated December 28.

17846. "Telephonic apparatus." G. L. ANDERS and OTHERS. Dated December 28.

17863. "Producing electrical energy for revolving axles of railway carriages." R. HASWELL. Dated December 29.

17888. "Electro-magnetic marine governors." G. A. SMITH. Dated December 29. (*Complete.*)

17902. "Apparatus for telephone exchanges." S. PITT. (Communicated by C. E. Scribner.) Dated December 29. (*Complete.*)

17905. "Making galvanic dry elements." C. GASSNER. Dated December 29.

17926. "Safety fuses for electrical circuits." W. E. HAYNE. Dated December 30.

17935. "Holders or attachments for incandescent electric lamps." P. CARDEW, W. P. BRETT. Dated December 30.

17965. "Machines for cleaning windows, mirrors, &c. by electrical power." F. REDMOND. Dated December 31. (*Complete.*)

17966. "Electric batteries and applying same to lighting miners' safety lamps." Os. Y. RHODES. Dated December 31.

18015. "Electrical connections for a number of telegraphic or telephonic stations." E. I. BERNHEIM. Dated December 31.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1886.

12222. "Electric apparatus for indicating time." R. J. RUDD. Dated September 25. 8d. Relates to apparatus worked by electricity for indicating time, either at one place where an electric clock is situated or at a number of places electrically connected with the clock. For this purpose the inventor provides a pendulum or balance and escapement, the escapement being worked intermittently by the action of a loaded or spring rack pawl upon a ratchet wheel connected to the escapement wheel. This pawl is intermittently moved in opposition to the weight or spring by the attraction of an electro-magnet, the coil of which is alternately brought into and out of circuit by rubbing contacts worked at intervals by the escapement. Connected to the pawl thus moved there are discs or barrels each of which is caused to move step by step at suitable intervals. These discs or barrels have marked on them numbers which, presenting themselves through holes in a plate or screen, indicate the time in hours and minutes. The escapement wheel may move a second's hand. From this primary electric clock or timekeeper conducting wires may extend to a number of time indicators, each having its discs or barrels to which movement is given by pawls worked by electro-magnets that are alternately brought into and cut out of circuit by the contacts of the primary clock. The claims are 3 in number.

12778. "Improvements in dynamo-electric machinery." S. F. WALKER. Dated October 7. 8d. Consists in building the armature entirely of iron in the form of sectors of a cylinder. Each sector is insulated from its neighbour on either side of it by suitable insulating material, but is connected electrically at one end to its neighbour on one side, and at the other end to its neighbour on the other side so that the whole of the sectors form one continuous conductor as in the copper wires of the Gramme ring. The claims are 3 in number.

14002. "A self-acting electro-magnetic combined switch and cut-out." J. M. V. KENT. Dated November 1. 8d. Consists of an electro-magnet wound with a coil of high resistance which is connected in shunt upon one or more of the sources of electromotive force, near this electro-magnet is a bar of soft iron, capable of movement about any fixed point in the base of the apparatus to which it is attached in a suitable manner by means of a pivot, spring, or otherwise. Upon this bar is wound a coil of low resistance and connected at one end with the source or sources of prime resultant electromotive force, and at the other end with an external circuit. At one end of this bar is placed an adjustable weight, and the other end makes or breaks the circuit aforesaid in any suitable manner such as by prongs dipping in and out of mercury cups and the like. The polarities of the armature and of the shunt coil are so arranged and the weight so adjusted that when the prime resultant electromotive force is as great or greater than the resultant electromotive force due to the other electromotive forces the circuit is closed by the movement of the armature; but when this latter resultant electromotive force is as great or greater than the prime resultant electromotive force the polarity of the armature being thereby reversed the polarity of the shunt remaining the same the circuit is immediatly opened by the movement of the armature. The claims are 2 in number.

14286. "A new or improved galvanic battery." A. WUNDERLICH and O. EISELE. Dated November 5. 8d. A convenient number of carbon or copper plates, preferably circular, are threaded alternately with similar zinc-plates on a shaft and secured thereon by two clamping plates or discs of wood or other suitable material fixed one on or over each end of the said shaft. The shaft is journalled or otherwise revolvably supported in a frame which supports a tank or receptacle situated above the plates and serving to contain the exciting liquid. A second tank is placed below the plates. The zinc-plates may be cast with raised frets on one of their surfaces of such a shape as to divide the surface into sector-shaped compartments of suitable number. In this case, when putting the plates together the zinc-frets are insulated by suitable packing from the carbon plates; or a separate perforated plate of non-conducting material representing and forming the said frets may be placed between each zinc-plate and the carbon plate on one side of it. The frets are so contrived that the sectorial compartments formed thereby may have one inlet and one outlet formed by two channels side by side extending from the rim of the plates towards the centre, where they terminate in the said sector-shaped compartments, at the apex of the latter. The upper tank is provided below with a number of valves corresponding to the spaces in the revolving battery. These valves are closed by conical plugs, which when drawn up, allow the liquid to flow on to the battery. In the liquid in the tank is also a float attached by an arm to a cam which controls the plugs, so that in proportion as the liquid and float descend, the plugs are raised by the cam so that the opening of the valves is proportional to the pressure of liquid, and the outflow therefore constant. The liquid falling on the outer sector wall of one of the compartments follows this until the entrance channel is reached when it enters this and gradually fills the respective sector; when the weight of liquid therein is sufficient to turn the battery the next compartment will be brought under the jets and filled and so on; as however the lowest sector begins to turn on its upward course, the liquid therein will flow out into the tank below, and so on with each sector, the empty sectors, passing upward and in due course arriving under the jets, are again filled and the process continues. As the liquid runs low in the upper tank, it can be supplied from the lower. By this apparatus the carbon plates will recover from the polarising effect of the solution whilst the sectors are empty. The claims are 4 in number.

15719. "Improvements in apparatus for administering electric currents." J. ROOTS. Dated December 1. 8d. Consists of improvements on the patent specification dated August 31st, 1886, and numbered 11,060. Claims:—1. The arrangement of appliances by which an electric current can be administered to a person moving handles and a beam, after the insertion of a coin, and when said coin by its weight has put two plates into contact for completing circuit, as described. 2. In an apparatus for administering electric currents, the employment of two plates put into electrical contact by the weight of a coin, as described, and substantially as shown in the drawings.

15776. "Improvements in compounds for covering insulated electric and other wires, and in the treatment of the same." F. WALTON. Dated December 2. 6d. Claims:—1. Covering wires with compounds, of which the principal ingredient is "elastic residue" or "tough pitch," and hardening the same by exposure to heat whilst wound upon a hardening cylinder, substantially as described. 2. Compounds substantially as described for covering wires, the principal ingredient of which is "elastic residue" or "tough pitch," and which also contain asbestos fibre or leather fibre. 3. Covering wires with compounds of which the principal ingredient is "elastic residue" or "tough pitch," then plating upon the same with cotton or other thread or otherwise enveloping it in a fabric, and afterwards applying over the fabric a thin layer of compound, substantially as described. 4. Covering wires first with a compound, of which the principal ingredient is "elastic residue" or "tough pitch," with asbestos fibre, and afterwards with a like compound with leather fibre, substantially as described. 5. Covering wires with compounds of which the principal ingredient is "elastic residue" or "touch pitch" with asbestos fibre, leather fibre, or other fibrous matter, and afterwards passing the same through a heated die, substantially as described.

15837. "Improvements in dynamo-electric machinery." J. A KINGDON. Dated December 3. 8d. Claims:—1. A rotating ring of laminated or divided inductors, secured and connected by means of non-magnetisable material, with one another and their support, whose outer surfaces are concentric with the axis of rotation and partially or wholly surrounded by fixed primary and secondary magnets, operating substantially as described. 2. The construction of the inducting surface in the form of an endless chain of magnetisable links laminated or divided, and connected and supported by non-magnetisable links, carried by a wheel or drum, substantially as described. 3. The conversion of a commercial engine into a dynamo-electric machine, by the application of such a chain of inductors to the periphery of the flywheel, in combination with a series of fixed primary and secondary electro-magnets, substantially as described. 4. The combination of such a chain of inductors with tension spokes to form a light and adjustable revolving wheel, substantially as described. 5. The combination of rotating inductors, laminated or divided with fixed secondary electro-magnets, the cores of which are also laminated or divided, and connected by laminated or divided yokes, and with primary electro-magnets also fixed. 6. The combination or rotat-

ing inductors, laminated or divided, with fixed primary and secondary electro-magnets, the cores of which are all laminated or divided and connected by laminated or divided yokes. 7. The various arrangements and modes of construction of the dynamo-electric machine and parts, substantially as described.

16151. "Improvements in primary voltaic batteries and in the preparation of the elements and solutions employed therein." W. WEBSTER, jun. Dated December 9. 8d. Claims:—1. In primary batteries the method of partially coating with wax the porous cells both inside and outside for restricting the interchange of the inner and outer liquids, substantially as described. 2. The described construction of the outer cell of a battery with mercury cups formed therein and with channels connecting the same so that single zinc or carbon electrodes may be removed without interfering with the action of the battery. 3. The described method of saturating the carbon electrodes with wax and paraffin so that the pores thereof are thoroughly impregnated, thereby preventing the creeping of acids up to the terminals. 4. The use for the inner liquid of a battery of a compound of nitrate of soda and bichromate of soda or chromic acid. 5. The use for the inner liquid of a battery of the several herein described solutions containing nitrate of soda and bichromate of soda or chromic acid in the proportions set forth. 6. The use of a compound siphon for charging or discharging several cells simultaneously constructed as described.

16157. "An improved construction or arrangement of switch for electrical purposes." A. SLATTER. Dated December 9. 8d. The inventor fits a rotatable stem in a suitable box or casing and encircles the stem by a coiled spring one end of which abuts against an arm projecting from the stem, the other end of the spring bearing against the cup or cover of the casing. The arm moves radially over a metal contact piece formed with a tooth or half tooth, the other half being formed of an insulating material upon the body of which the arm can also be moved. The stem is surmounted by a button which it is necessary to pull outwards to compress the spring and lift the contract arm over the tooth; the rebound of the spring when the button is released forces the arm to the bottom of the tooth on either side whether for switching the current on or off. The tooth is sufficiently high to resist any slip or sliding action of the arm so that the button and stem must be raised to be cleared from one to the other. The stem is extended somewhat beyond the arm into an aperture serving as a guide but in conjunction with a hole in the cover compels the stem to have a straight action when pulled upon for turning it for switching purposes. There is 1 claim.

16201. "Improvements in and relating to the transformation and distribution of electric energy and appliances therefor." R. DICK and R. KENNEDY. Dated December 10. 8d. According to one arrangement of the present improvements, the central iron core portion or organ of the secondary generator of alternating currents is constructed of thin sheet iron annular disc rings, having projecting or radial teeth formed round their outer circumferential edges or surfaces, and having a hole in the centre forming them into rings, or it might be hollow polygonal forms. These thin discs or rings are built together with some slight insulating material, such as paper, between them, to form an annular armature, the spaces between the teeth forming channels on the outer and inner surface for the purpose of retaining the two conductors, precisely similar to what is done in the well known armature for dynamo-electric machines known as the Pacinotti armature, and also in the drum winding common to the dynamos of Weston and others. In the channels or spaces between the projecting teeth, the primary and secondary conductors are wound or laid side by side, or one over the other in sections. The sections of the primary conductor are connected together so that when the primary current flows, the iron teeth form magnetic poles alternately of north and south polarity all round the circumference of the ring discs; and the secondary sections of wire may be connected in series or in parallel order as may be found necessary for the purpose. Finally an outer sheath of iron wire is wound over the outer periphery of the drum or discs, so as to enclose the whole and form a magnetic shell. The claims are 7 in number.

16326. "Improvements in and relating to the transformation and distribution of electric energy." R. DICK and R. KENNEDY. Dated December 13. 8d. According to this invention, the inventors use in combination with two main current transformers having their secondary wires joined in series order, a system of main conductors known as the three-wire system and hitherto practised for the purpose of distributing low potential currents directly to the lamps or other translating devices. To apply this system for the purpose of providing main supply conductors for high potential alternating currents, and applicable to the operation of secondary generators, they employ a low potential alternating current dynamo machine, this low potential dynamo machine delivers its currents of electricity into the primary wires of two main current transformers, which primary wires are joined in multiple arc or series order, to the terminals of the low potential dynamo-electric generator, or it might be a number of these generators. The secondary wires of the two main current transformers are joined together in series order, the two free ends are then joined up to two main supply conductors, which pass through the district to be supplied with alternating electric currents of high potential for operating secondary generators. At the junction of the two secondary wires of the main current transformers, a third main supply conductor is connected; this third wire also passes between the other two main conductors through the district to be supplied with high potential alternating electric currents. The claims are 4 in number.

16408. "Improvements in or relating to electric accumulators." A. J. BOULT. (A communication from P. J. R. Dujardin, of Paris.) Dated December 14. 8d. Instead of leaving the oxidising of the lead exclusively to the oxygen of the water, the inventor produces the oxidation by an acid solution with an addition of an oxidising acid or salt, which produces by the passage of the current a soluble salt of lead which is continuously decomposed by the sulphuric acid and passes into the state of peroxide of lead. The inventor employs a bath composed of 10 kilogrammes of water, 2 kilogrammes of sulphuric acid, and 1 kilogramme of nitrate of soda, by which a formation of nitrate of lead is transformed continuously into sulphate and then into peroxide of lead. In a few hours, without either discharge or back current, the positive lead strips will be covered by an adhering and crystalline coat of peroxide of lead of a great electric capacity, and which even may exceed ½ millimetre in thickness. To increase and regulate the formation of the salts of lead, it is found indispensable to introduce great volumes of air into the bath. This is done either by blowing the air in or by lifting the pole plates out, or by any other convenient means. The action is doubled in this manner irrespective of the composition of the bath. To give the coat of peroxide a greater adherence to the lead, the strips are covered with small cells of very small dimensions which are arranged in the thickness of the lead but do not pierce it. The peroxide, even at the expense of the lead, fills these cells in a few hours with a perfect adherence to the lead. The leaden strips submitted to an energetic formation elongate at least 10 per cent. of their length; it is therefore impossible to place them rigidly into a frame; to this end the inventor suspends these strips from rods to which they are soldered or otherwise suitably connected. This rod is so bent that when placed across the accumulator vessel it will be immersed in the bath as well as the strips. In this manner the elongation can take place without difficulty towards the bottom of the vessel. To prevent the lead strips piling up against each other so as to impede the free circulation of the gases, the strips are obliquely undulated so that when they touch each other they are only in contact at a small number of points.

CORRESPONDENCE.

Compound-Wound Dynamos.

The board of the Anglo-American Brush Electric Light Corporation have had their attention drawn to the articles from the pen of Mr. Varley which have appeared in your recent issues. As a rejoinder from the Corporation is perhaps looked for in some quarters they think it well at once to state that, in their opinion, the scientific journals do not form a proper medium for the discussion of a question of this character, which can only be satisfactorily disposed of in a court of law.

The Corporation have, by instituting proceedings against the firms who disputed their claims, shown their complete confidence in the justice of the position they have taken up, and the board are prepared to carry this policy to its final issue should it be thought necessary by any manufacturer of dynamo machines who is not licensed by the Corporation.

In the event of any of the firms who have accepted licenses from the Corporation feeling that the statements made by Mr. Varley call for explanation, the Corporation will be happy at all times to afford them the fullest information.

E. Garcke, *Manager and Secretary,*
ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION LIMITED.

January 4th, 1888.

Sir William Thomson's Current Balance for Alternate Currents.

Referring to this instrument, which is made with insulated copper wire rope, instead of solid copper, for its coils, Mr. Swinburne says in your last week's issue:—"The use of cable prevents the current distributions from being altered by the mutual induction of the coils. In cases where there is only one turn, or even where there are only a few turns, this method does not prevent the error from the wire itself." The first sentence here quoted is correct; the second not so. In fact, the truth of the first, as a practically approximate

statement, disproves the second. *To exactly the same degree of approximation*, as it is true that mutual induction between the coils is, by the "cable" formation of the conductor, prevented from altering the distribution of the current among the different wires, the change of distribution among the wires produced by self-induction in each coil is prevented from rendering the mutual force between fixed and movable coils different from what it would be if the current were equally distributed among the wires. To as nearly as may be realise this condition in the construction of the instrument, a complete twist, exactly once round, is given to the portion of rope constituting any one complete circle of each coil.

William Thomson.

The University, Glasgow,
January 4th, 1888.

Navigation by Electric Light.

I have heard and read a great deal about the navigation of narrow waterways, like the Suez canal, by means of the electric light, and I understand that it is thought by experts to require a very special apparatus. As such a waterway is continuous without sharp curves, and is only 86 miles in length, I think that any simple combination of an automatic arc lamp and a reflector would be sufficient, and if the ship have a dynamo there would be no difficulty in supplying the light for the navigation at night. I certainly do not see why a special apparatus is required.

Navire.

The Mercurial Air Pump.

As I till lately have paid but little attention to the above subject, Prof. Thompson's paper has given me a fund of information on which others were already somewhat posted. Reading, however, Mr. C. V. Boys's discussion, I noticed about the heating of the mercury, and on this point I should like to offer a few remarks.

Firstly, as to the heating of the mercury bulb; the glass is the first to get hot, and the mercury vapour will therefore rise from the *sides* first and surround the air, which being warm, keeps as high up the bulb as possible (*i.e.*, near the *centre*). The air, therefore, has but little chance of escape, being hemmed in, but gradually becomes mixed up with the vapour. When this vapour cools, the air is again set free.

On the other hand cold air is heavy, and sinks. Why could not the air be cooled, and the mercury let in from above, forcing the air out *downwards*, which could be prevented from re-entering by means of a valve opening downwards.

This is but a suggestion, but I should much like to know if my supposition is correct.

Charles Latimer.

The Measurement of Alternating Currents.

It is a little difficult to know exactly what Captain Cardew is aiming at in his letter. There is no reason why the electrician should borrow his engines and dynamos in order to trot out his wattmeter. He is at perfect liberty to buy them. He does not necessarily borrow them in direct current work, though, sad to say, he often does not pay for them.

Surely Captain Cardew has missed the whole point of the wattmeter question, namely, that a wattmeter is accurate, whereas a voltmeter does not, in the cases mentioned, give any useful information. If the dynamo works a closed iron circuit transformer designed according to certain principles, it may be safe to work with a voltmeter and ammeter; but as transformers so far have generally been made almost at random, such treatment could not be described in my articles without carefully pointing out the chances of error.

I am sorry Captain Cardew does not believe in the twinkling of a lamp. If he thinks the occupation is monopolised by stars and bedposts I cannot help it. Does he admit the twinkling of a Cardew voltmeter? I have never tested an incandescent lamp with a Cardew voltmeter and direct and alternating currents, but would do so at once if the apparatus were at hand. It would be an easy and a valuable experiment for someone who has them. In the summer of 1884 I made some experiments on lamps under alternating currents. To my astonishment a lamp took a larger virtual current with an alternating current. The most obvious way of accounting for this is by errors of experiment. Another is by supposing the resistance of carbon to increase with temperature, but to decrease with current density. It was to see if the resistance depended on the current density that the experiments were made. This was disproved afterwards. A lamp was run at full candle power, and the resistance taken. The same current was then sent through the carbon at 300° F. or so, and the resistance taken. The resistance was again taken at 300° without the current, and was the same as before.

Jas. Swinburne.

Electrical Students and Alternating Currents.

I must thank "Student" for his letter and the remarks he makes, but am afraid I can do little to help. The difficulty in making clear the section of my articles on alternating currents has been very carefully considered. At first it seemed best to expand that part, so that it became a short treatise on alternating currents. This in itself would have objections, as I should have to introduce mathematics, while mathematics, or at least mathematical notation, had been so far carefully avoided, and, again, it would have made the series far too long. It, therefore, seemed best to treat of measurement only, and use a dogmatic instead of an explanatory tone. The authoritative style should be avoided in all scientific writing, but in this case it could hardly have been helped.

The difficulty "Student" mentions is, however, by no means peculiar to the study of alternating currents. Prof. Joubert, Dr. Hopkinson, Mr. Blakesley, Mr. Snell, Mr. Kapp, and Mr. Gray have all written on alternating currents, but I do not know how far they would assist "Student." The difficulty of studying a new branch of practical science is always that the student has to puzzle things out very much for himself, and read things critically. The idea that such things as the design of dynamos or transformers can generally be taught at training colleges is wrong, because improvements go on too rapidly. With one or two exceptions teachers cannot find out about such things until practical engineers choose to publish their knowledge, so that the teachers must always teach theories that are to some extent obsolete. When electrical engineering began, practical engineers knew so little that science teachers could tell them most things about their own work, but now practical men have generally as thorough mathematical and scientific knowledge as teachers, and as their attention is wholly devoted to electrical engineering they go in front of scientific teaching, not behind it. The result is that schools of electrical engineering will soon take the same place as schools of mechanical engineering, that is to say, a student will study there for some years, and will then spend some years in the shops and designing departments; they will then have what is indispensable, both sides cultivated.

No one can be more willing to urge the necessity for training colleges than one who has had to work up his "theory" alone; but it cannot be too carefully borne in mind that a training college is not the place to learn such things as design of alternating current machines. If the student spends his time working up mathematics, chemistry, and physics, he will never repent it; but if he studies design there he will often find he has been spending his time over what a brilliant writer calls "Hypothetics."

Jas. Swinburne.